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ORIGINAL

FOLLOWUP ANALYSIS OF SULFUR DIOXIDE EXCESS AT KINGSTON STATION 7 ON FEBRUARY 8-10, 1980

AIR RESOURCES PROGRAM

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Office of Natural Resources

Air Resources Program

FOLLOWUP ANALYSIS OF SULFUR DIOXIDE EXCESS AT KINGSTON STATION 7 ON FEBRUARY 8-10, 1980

Prepared by

Kenneth G. Wastrack

Muscle Shoals, Alabama

June 1981

I

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II

FOLLOWUP ANALYSIS OF SULFUR DIOXIDE EXCESS AT KINGSTON STATION 7 ON FEBRUARY 8-10, 1980

Scope and Objectives

On February 8-10, 1980, sulfur dioxide (SO_2) levels in excess of primary and secondary National Ambient Air Quality Standards (NAAQS)[1] were measured at monitoring station 7 near the Tennessee Valley Authority's (TVA) Kingston Steam Plant. TVA's Air Resources Program (ARP) thoroughly investigated and evaluated the incident and reported the findings.[2] Since then, new information has been obtained concerning the incident and station 7. This followup analysis reexamines the earlier findings in terms of this new information, to decide if any conclusions need to be revised.

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1. For SO_2, the primary standard (for protection of public health) is 0.14 parts per million (ppm) for a 24-hour average; the secondary standard (for protection of public welfare) is 0.50 ppm for a 3-hour average. These standards are not to be exceeded more than once per year.

2. Analysis of Sulfur Dioxide Excess at Kingston Station 7 on February 8-10, 1980, TVA/ARP - I80/28, Tennessee Valley Authority, Muscle Shoals, Alabama, August 1980.

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October 8, 1981

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Background

Before discussing information obtained since the report, it is useful to briefly describe the incident and the earlier evaluation.

Description of February 8-10, 1980 Excess

Highest SO_2 concentrations were measured during the period from 0730 CST on February 9, 1980 to 0140 CST on February 10, 1980. SO_2 concentrations increased over a 12-hour period in four relatively discrete steps, remained offscale (more than 0.98 ppm) for six hours, dropped to about 0.30 ppm within a few minutes, and then to background levels within three hours.

This incident was unusual since station 7 recorded only one off-scale reading--less than eight minutes in duration--during the previous four years (1976-1979). During that reading, units 1-5 were exhausting emissions through individual stacks 76 to 91 meters tall and units 6-9 were exhausting emissions through a single 305-m stack. Since full use of the 305-m stacks began in 1977, no 3-hour averages have been higher than 0.21 ppm.

Weather conditions were a significant factor during the period when SO_2 concentrations were off-scale. Winds were generally from the north (1-6° at 110 m). Wind direction persistence was greater than 90 percent and wind speeds were generally in excess of 6.5 meters per second (m/sec). SO_2 concentrations dropped quickly when wind directions changed from the north.

Discussion of Previous Analysis

Relevant physical and environmental conditions which existed during the incident were analyzed in detail. Factors examined included topography in the vicinity, meteorological and ambient air quality, and probable SO_2 emissions from nearby sources.

It was determined that each of the major emission sources was, individually, incapable of causing the excess. Three other explanations, (1) instrument malfunction, (2) unidentified sources of SO_2, and (3) non-SO_2 sampling, were examined and rejected because of insufficient supporting information. The most likely explanation was that a combination of several sources (specifically Union Carbide K-25 Gaseous Diffusion Plant and Oak Ridge urban area) caused the incident. However, this explanation required assumptions creating an unlikely combination of terrain and meteorological conditions. The report concluded that neither Kingston nor Bull Run Steam Plant was a significant contributor to the excess.

New Information

Data Validity Investigation

Data Services Branch (DSB) investigated the validity of the data collected by (1) examinating the maintenance and calibration history of the SO_2 monitor at station 7, (2) comparing the strip chart trace recorded during the incident with strip chart traces from known SO_2 measurements and from known instrument malfunctions, and (3) evaluating an analysis of the incident by an independent consulting company.

Maintenance and Calibration History--For the period January-March 1980, a somewhat greater-than-usual field maintenance/service activity was necessary for this monitor. In all cases, a low airflow problem was indicated. It must be noted that a low airflow would result in less than actual SO_2 being measured. In all other respects, validity criteria for monitor operation were satisfied.

Examination of Strip Chart Trace--The overall response of the monitor was more sluggish and periodic than a typical Philips monitor trace. Also, the large drop from more than 1 ppm, at 0140 CST on February 10, 1980, is uncharacteristic. All other aspects before, during, and after the incident indicate normal operation.

Independent Evaluation--An outside contractor examined the circumstances related to the incident and was unable to make any different conclusions concerning the cause of excess. It was recommended that several experiments be performed to determine whether situations specified by the contractor could have caused the high reading. DSB conducted the experiments and determined that the problems suspected were not likely to have caused the trace observed.

Based on this investigation, DSB concluded that the Kingston station 7 SO_2 monitor was operating properly according to TVA validation procedures, so that all data are considered valid. In addition, no other possible explanations were identified which might cause a fictitious trace, similar to the February 9-10 trace.

DOE Ambient Monitoring Data During Excess Period

Subsequent to the completion of the earlier report, ARP obtained (from the Tennessee Division of Air Pollution Control) ambient SO_2 monitoring data collected at stations operated by the Department of Energy (DOE) on the Oak Ridge reservation (figure 1). Station A (21.6 kilometers [km] east-northeast from station 7) recorded only background levels of SO_2 (0.005 ppm--3-hour average) during the period when Kingston station 7 was off-scale. Station B (20.6 km northeast from station 7) also recorded very low concentrations (maximum 0.081 ppm--3-hour average) during the February 8-10, 1980 period. Table 1 gives a summary of significant SO_2 concentrations recorded at these stations.

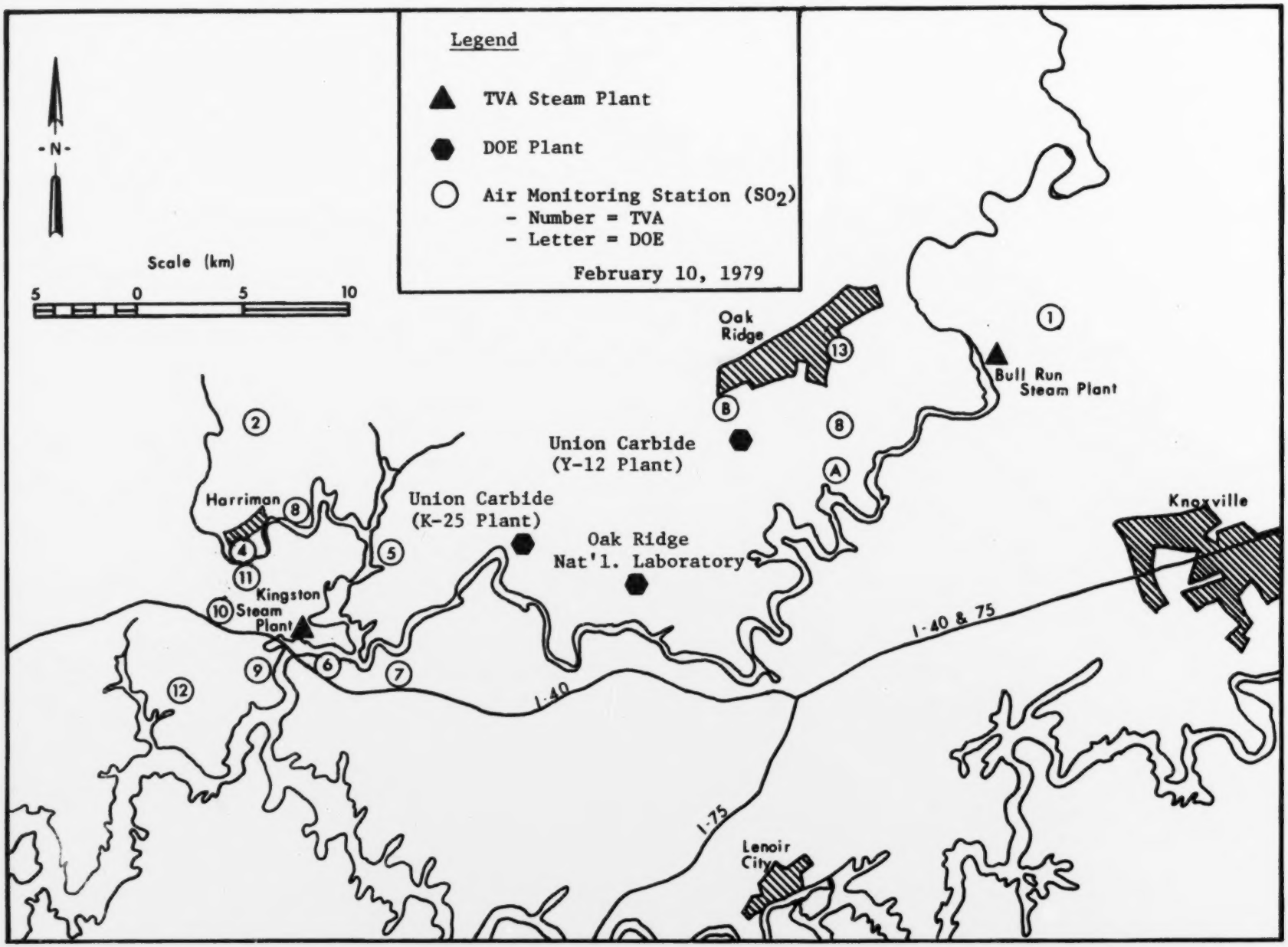

Figure 1. TVA/DOE AMBIENT SO_2 MONITORING NETWORK - BULL RUN/KINGSTON STEAM PLANT VICINITY

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Table 1

AMBIENT SO_2 MONITORING DATA
UNION CARBIDE Y-12 PLANT
(SIGNIFICANT VALUES)

Date	Hour Ending (CST)	3-Hour Running Average Concentration (ppm) Station A	Station B
February 8, 1980	0800	0.005	0.077
	0900	.005	.069
	1000	.005	.077
	1100	.005	.071
	1200	.005	.081
February 9, 1980	1900	.005	.005
	2000	.005	.005
	2100	.005	.005
	2200	.005	.005
	2300	.005	.005
	2400	.005	.008
February 10, 1980	0100	.005	.013
	0200	.005	.015

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The measurements are particularly significant since the DOE monitoring stations are located between Kingston station 7 and the Bull Run Steam Plant/Oak Ridge urban area. Therefore, it would be expected that these stations would record significant SO_2 concentrations if these sources were significant contributors to the excess at Kingston station 7. The lack of such SO_2 concentrations tends to eliminate both sources as likely contributors.

The two Union Carbide plants (Y-12 and K-25) and the Oak Ridge National Laboratory on the DOE Reservation cannot be eliminated as potential sources. Since these sources are located between station 7 and the two DOE monitoring stations, it is possible for emissions to impact station 7 while remaining undetected at the DOE stations.

TVA Ambient Monitoring Data Since Excess

ARP examined ambient monitoring data collected at station 7 since the February 8-10, 1980 incident. One-hour peak concentrations were equal to or greater than 0.30 ppm only five times in that interval; they are summarized below (Table 2).

Table 2

KINGSTON STATION 7

SIGNIFICANT SO_2 CONCENTRATIONS

FEBRUARY 11, 1980 - MARCH 31, 1981

Date	Time (Hour Ending)	Peak SO_2 Concentration (ppm)	1-hour Average SO_2 Concentration (ppm)
February 24, 1980	1200 CST	0.31	0.13
April 25, 1980	1100 CST	0.52	0.07
	1200 CST	0.30	0.14
April 30, 1980	1200 CST	0.38	0.08
	1300 CST	0.44	0.23
May 22, 1980	1200 CST	0.48	0.03
October 7, 1980	1100 CST	0.55	0.12

None of these cases are similar to the February 9-10, 1980 measurements in terms of time of day, magnitude of concentration, or duration of significant concentrations. Also, winds during these cases are not comparable with winds during the February incident based on direction, speed, or persistence (table 3).

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Table 3

KINGSTON STEAM PLANT

SIGNIFICANT SO_2 CONCENTRATIONS

FEBRUARY 9, 1980-MARCH 31, 1981

Date	Time	Station 7 SO_2 Concentration (ppm)		110-m Winds		
		Peak	1-Hour Average	Wind Direction (°)	Wind Speed (m/s)	Wind Direction Persistence (%)
February 9, 1980	2000	0.98	0.94	6	3.2	79
	2100	.98	.98	6	3.7	91
	2200	.98	.98	1	6.7	91
	2300	.98	.98	3	6.8	90
	2400	.98	.98	6	6.5	92
February 10, 1980	0100	.98	.98	6	7.1	96
	0200	.98	.68	11	7.1	95
February 24, 1980	1100	.15	.08	345	3.0	43
	1200	.31	.13	345	2.5	38
	1300	.18	.11	44	1.9	20
April 25, 1980	1000	.01	.01	142	1.4	15
	1100	.52	.07	359	1.1	24
	1200	.30	.14	29	0.9	34
	1300	.07	.04	58	2.1	28
April 30, 1980	1100	.01	.01	19	2.7	52
	1200	.38	.08	18	1.6	26
	1300	.44	.23	153	2.4	45
	1400	.10	.04	200	2.4	35
May 22, 1980	1100	.02	.02	71	2.8	53
	1200	.48	.01	82	2.5	79
	1300	.02	.03	67	2.7	54
October 7, 1980	1000	.00	.00	54	0.7	23
	1100	.55	.12	105	1.3	17
	1200	.19	.04	209	2.5	57

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Influence of New Information on Previous Report

The new information obtained since the February 8-10, 1980 SO_2 excess at Kingston station 7 concerns: (1) validity of measurement, (2) likely emission sources which caused the excess, and (3) the probability of a recurrence of a similar excess.

Validity of Measurement

Although the measurement is not characteristic of a normal SO_2 trace, there is no supporting evidence to indicate any type of malfunction or interference. All data are valid based on conventional validation procedures. It must be noted that merely because a measurement cannot be discredited or ruled invalid should not imply that the measurement is valid beyond doubt. The procedures for validating data are negative; a measurement is considered valid until evidence is found to indicate otherwise. It may be that validation procedures are not complete and thorough enough to detect or uncover the reasons why the Philips instrument at station 7 may have recorded a false reading on February 8-10, 1980.

Likely Causative Emission Sources

The additional ambient monitoring information provided by the two DOE monitoring stations tends to eliminate the Bull Run Steam Plant and Oak Ridge urban area as major contributors to the excess. It is highly unlikely that these sources could cause an excess of the magnitude observed at station 7 without a significant levels of SO_2 also being measured at one of the DOE

stations. The lack of SO_2 concentrations at the DOE stations does not eliminate the facilities on the Oak Ridge reservation as potential causes of the excess, since these facilities are all located between the DOE stations and Kingston station 7.

Probability of Recurrance

No concentrations similar to the February 8-10, 1980 incident have been observed at Kingston station 7 either before or after the incident. This is clearly illustrated in figure 2 which shows a high peak in February 1980 with low values over the rest of the period. This extremely unusual behavior suggests instrument malfunction. Based on this and the previous evaluation, it is expected that SO_2 levels in excess of standards will not recur.

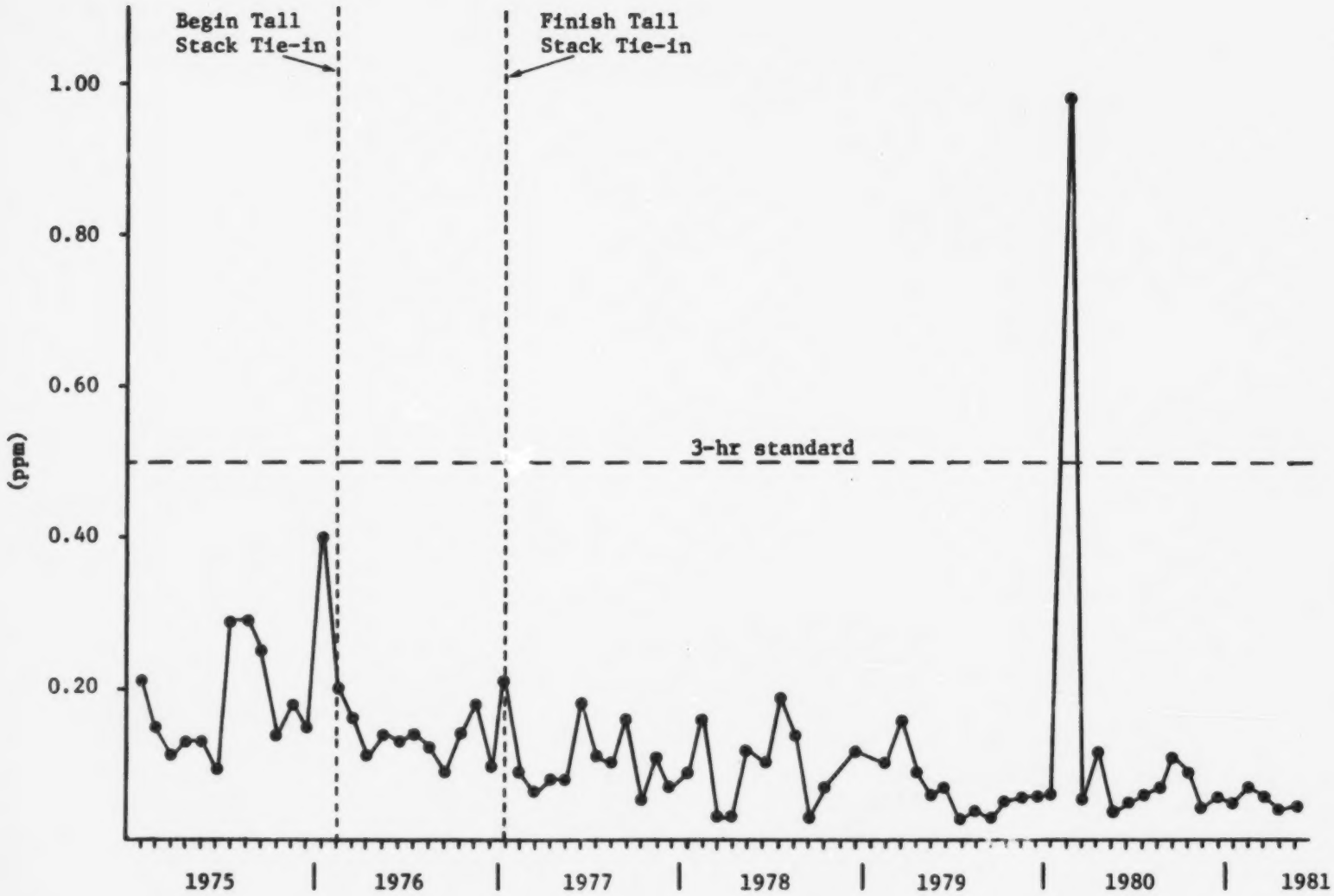

Figure 2. MAXIMUM MONTHLY 3-HR AVERAGE SO_2 CONCENTRATIONS AT KINGSTON STATION 7, JANUARY 1975-JUNE 1981.

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Summary

Several items of information on the SO_2 excess at Kingston station 7 on February 8-10, 1980, investigation became available after the initial investigation was completed. Although the SO_2 strip-chart trace has several irregularities, there is no further evidence of instrument malfunction or interference. Ambient monitoring information from DOE stations on the Oak Ridge reservations measured maximum SO_2 concentrations only slightly above background levels. This tends to exclude Bull Run Steam Plant or Oak Ridge urban area as significant contributors to the excess. No similar combination of meteorological or ambient monitoring conditions has occurred either before or since the incident.

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Conclusions

1. Bull Run Steam Plant and Oak Ridge urban areas were probably insignificant contributors to the February 8-10, 1980 excess at Kingston station 7. Only three facilities on the DOE Reservation can be considered as likely contributors to the excess (either individually or in combination): Union Carbide K-25 plant, Union Carbide Y-12 plant, and Oak Ridge National Laboratory.

2. There is no evidence to indicate an erroneous measurement. The SO_2 concentrations observed are valid according to all conventional validation techniques.

3. No similar combination of meteorological and ambient monitoring conditions has occurred before or since the February 8-10, 1980 excess. Therefore, that incident should probably be considered as a one-time event.

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Appendix A

Data Services Branch

Investigation of Data Validity

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Kingston

TVA 84 (08-65)

UNITED STATES GOVERNMENT

Memorandum

TENNESSEE VALLEY AUTHORITY

TO : John P. Blackwell, Chief, Air Resources Program, ROB-M

FROM : H. Smith, Chief, Data Services Branch, 350 EB-K

DATE : ber 29, 1980

SUBJECT: VALIDITY INVESTIGATION OF FEBRUARY 9-10, 1980, SO_2 EPISODE RECORDED AT KINGSTON MONITORING STATION 7

The investigation of the validity of the February 9-10 SO_2 data from Kingston monitor 7 is reported in three sections.

Section I is a reevaluation of the initial validation provided by Data Services Branch in the "Air Quality Excess Report" No. 13, February 15, 1980. Section II is an independent investigation of the event provided by Enviro-Measure, Inc., in the form of a letter (Attachment 2). Section III provides additional evaluations following the recommendations of Enviro-Measure, Inc. (Attachment 2), and conclusions drawn from the combined Sections I and II.

I Data Services Branch Reevaluation of Initial Validation

The validity of the ambient SO_2 data at Kingston No. 7 for the period February 9-10 has been reexamined and findings are summarized in the following discussion.

The reason for this rereview is as follows: (1) to see if additional maintenance/calibration or other information was available following the initial validation report of February 15; (2) to respond to concerns within Data Management Section (DMS) and Office of Power relative to unexplained comments marked on the chart by DMS indicating anomalous traces and frequent maintenance activities during or just prior to the episode.

Initially, the maintenance and calibration history of Philips PW9700 No. 7 at Kingston in the first quarter of 1980 was reexamined. Secondly, the strip chart trace was studied in greater detail by DMS and Air Standards Laboratory personnel in an attempt to explain some of the unusual characteristics in the trace which could provide additional insight into the validity or nature of this data.

The maintenance and routine service visits for the three-month period (January-March 1980) indicated a somewhat greater than usual field maintenance/service activity for this monitor, averaging almost three times per week. This frequent visitation schedule was a result of a low airflow problem that repeatedly occurred at this monitoring station. However, in all cases, the total airflow check at the regular weekly servicing indicated the low airflow. The resulting maintenance recorded in the Trouble Reports indicated that the measuring or flow orifice was dirty and cleaning the orifice and adjusting the reference voltage corrected the problem. The worst low flow observed before maintenance was

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performed was -7.9 percent. It should be noted that low airflow problem is the most common type of problem associated with the Philips PW9700 monitor and results in less SO_2 being measured than when the flow is not restricted.

The calibration schedule was routinely followed for this period with the one additional calibration following the February 9-10 episode. All calibration results were within tolerance with average errors over the period less than 5 percent. The "as found" calibration of February 13 indicated the monitor accuracy to be within 6 percent.

Daily zero/span control charts indicated zero drift of less than 2 percent from February 10 to 12. The zero was adjusted on February 14 following the "as found" calibration.

The calibration and span data do now show errors of 15 percent or greater in the weeks immediately before, during, and after the episode which means that the data satisfy the primary validity criteria according to Quality Assurance Procedure DSB-DMS-5.2 - Sulfur Dioxide Data Validation.

Chart Discussion

The overall monitor response during the episode, as indicated by the recorder trace (Attachment 1a) appears more sluggish and periodic than a typical Philips monitor exposed to ambient SO_2 levels (Attachment 1b). Also, the descent from a level of greater than 1 ppm (beginning at about 1:40 a.m., February 10) to near zero level by about 3 a.m. is uncharacteristic of previous SO_2 episodes observed at TVA monitoring stations. However, the rise time during each major step, and the fall time at the end are normal for the Philips PW9700.

Zero/span checks on February 9 preceding the episode, and on February 11 following the episode indicate the electronics and measuring cell performing correctly. The "as found" calibrations performed on February 13 were also within limits. Any malfunction of the monitor that we have experienced will usually not correct itself and perform normally without repair.

A flow decrease on the order of 75 percent could cause sluggish response. However, since the monitor response is directly proportional to the flow, the ambient SO_2 level seen by the monitor would have to be in excess of 4 ppm to drive the monitor offscale. If the internal source purge orifice was totally plugged, SO_2 would migrate into the measuring cell. This would cause a gradual upscale drift continuing until the problem was corrected. The trace would not show the variability shown here if this was the problem.

Amplifier unbalance and contaminated electrolyte generally result in an elevated zero and noisy trace which was not observed before, during, or after the period of February 9-10.

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John P. Blackwell
September 29, 1980

VALIDITY INVESTIGATION OF FEBRUARY 9-10, 1980, SO_2 EPISODE RECORDED AT KINGSTON MONITORING STATION 7

II Independent Evaluation by Enviro-Measure, Inc.

Since nothing had been found by Data Services Branch or Air Resources Program to explain the unusual character of SO_2 record of February 9 and 10, Dr. Terry Miller of Enviro-Measure, Inc., was asked by Bob Beebe if he would look at the chart trace and give his professional opinion and recommendations as to what he thought could have been occurring at Monitor No. 7. Dr. Miller agreed to do so and his findings and recommendations are included in his letter of September 25, 1980 (Attachment 2).

III Final Evaluations and Conclusions

In response to Enviro-Measure's recommendations (1) and (2), additional testing was performed to see if the trailer environment could have "created" the excess due to an intake or flow blockage, for example.

On September 24, Field Investigations personnel restricted the inlet line at station 7 and allowed the instrument to run overnight. The resulting trace only approached 1 percent of scale. In addition, calculations showed that it would take six days for a concentration to build to 1 ppm within the building assuming a portable 1 ppm calibrator had been left in the monitoring trailer. The field personnel who first went to the site on February 13 following the excess verified that a portable calibrator had not been left at the station nor did they find any evidence of tampering or localized sources of SO_2 or interference.

In summary, the data February 9-10, 1980, from monitor No. 7, Kingston, remains valid as was initially reported. This conclusion is based upon following conventional validation procedures which demonstrate that the monitor itself was operating well within precision and accuracy tolerance limits of TVA which have been established based upon U.S. Environmental Protection Agency (USEPA) guidelines. In addition, various postulated scenarios which might cause a fictitious trace similar to that which was observed on February 9-10 were investigated but the subsequent testing indicated negative results.

Nevertheless, the unusual trace of the chart at monitor No. 7 remains unexplained (except for the meteorological explanation in Attachment 2; conclusion 4) and therefore the possibility of undetected tampering, interference, or a transient malfunction cannot be entirely ruled out. Additional studies could be performed to further define the nature of a source external to the monitoring station.

If you have any questions or require additional information, please do not hesitate to contact Bob Beebe.

Claude H. Smith

RCB:BB
Attachments
cc: Robert N. Kennedy, 415 PRB-C
Douglas R. Neeley, ROB-M

Prepared by Robert C. Beebe

Enviro-Measure, inc.

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P.O. Box 2511, Knoxville, Tn 37901 3028 Magnolia Ave., Telephone: 615-523-2911

September 25, 1980

Mr. Bob Beebe
TVA DATA SERVICES BRANCH
400 Commerce Avenue
310 Evans Building
Knoxville, Tennessee 37902

Dear Bob:

As per our meeting of September 19 and your request, Mike Claggett and I have performed an analysis of the SO_2 excess observed at TVA's air monitoring station #7 near Kingston. Since we had only a short time available to conduct our analysis, it is not as thorough or exhaustive as we would like. This letter presents: (1) The things we did, (2) Our findings, (3) Our interpretation of the results, and (4) Our recommendations.

Things we did:

1) Analyzed the strip chart recording of the event
2) Analyzed meteorological data from (a) TVA's Kingston tower, (b) a private wind instrument in Rockwood, and (c) local climatological data from Knoxville's NWS station
3) We read your report on the analysis of the validity of the Phillips SO_2 data
4) We read Roy Carter's "Analysis of the SO_2 Excess"
5) We analyzed SO_2 data from the other monitors in the Kingston Network
6) We looked at the flow schematic for the Phillips PW 9700
7) We visited monitoring station 7 and 11 on September 22 and discussed station operations with Chuck Bach, Jim Hamby, Sherman Casteel, and Joe Wallace
8) We revisited the site on September 24 to look at the location of known SO_2 sources in the area, to look more closely at the terrain and to attempt to find previously unknown sources located in the same valley as monitor #7
9) We performed some simple dispersion modeling

Our Findings:

1) The strip chart recorder trace is unusally smooth, with plateaus at approximately 0.2, 0.4, 0.9, and 1.0 ppm. The trace included regular, almost sinusoidal, variations in pollutant concentration. The amplitude of the sinusoidal variations was proportional to the average SO_2 concentration. Variations were typically within ± 20% of the average SO_2 concentration being measured.
2) If the sample inlet line becomes clogged or restricted enough to cause greater than -0.5 inches (w.d.) of pressure

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at the instrument detector cell, the instrument samples air inside the building (dimensions, 8' wide x 10' long x 7' high) instead of pulling in air from outside. Under these circumstances, room air is drawn through a small bubbler containing silica oil prior to entering the detector cell.

3) The episode began at 7:30 am on February 9, 1980. During this time (and since 1:00 am) the NWS station reported snow with a temperature of 33°F. During the day 5.6 inches of snow fell. There was 100% cloud cover all day. All day, the weather station reported snow, fog, rain, drizzle, and ice pellets. The episode ended at 1:40 am on February 10. During the episode the highest temperature recorded at the Kingston tower was 32.8°F; the low was 29.3°F. Delta temperature measurements at the Kingston tower do not indicate particularly stable conditions, however the lower level air temperature measurement may be somewhat influenced by the large surrounding water body, the temperature of which was 45°F.
4) Station #7 is the only air monitoring site in the narrow valley northwest of Pine Ridge. This valley has general NE-SW alignment, bounded by Pine Ridge to the southeast and by the unnamed ridges which form the bank of the Clinch River to the northwest. None of the other 9 SO_2 monitoring stations measured anything more than normal background SO_2 levels.
5) Several factors indicate possible stable atmospheric conditions, especially near the surface (i.e., the wind shear measured at the Kingston tower, low surface wind speeds, snow cover on the gorund, and the general low speed, down valley flow measured all day at the NWS site.)

Conclusions:

1) We do not know what caused the SO_2 excursion.
2) The smoothness of the strip chart recorder trace implies either: (a) that the recorder response was slower than usual (probably due to a low flow rate) or (b) that the SO_2 concentrations were well mixed within the air mass being sampled.
3) even though the sampling inlet head is heated, I cannot rule out the possibility that the fine mesh inlet screen (ahead of the heated section) became clogged with snow or ice on this day. (The screen was covered with spider webs when we observed it on September 22.) Once the line is clogged the instrument will sample air inside the building. The SO_2 permiation source emits at too low a rate, however, to fill the building with SO_2 (eg. calculations showed > 100 days would be required to fill the building to a concentration of 1 ppm). Some other source of SO_2 would have to be present, such as a portable calibrator.
4) If the measured SO_2 concentrations were in the outside air, then the air mass containing the SO_2 was most likely confined to the valley containing the monitor since SO_2 levels were low at all other sites. The smooth trace means the SO_2 must have been well mixed within the narrow valley. Simple modeling shows that a large source emitting > 100 g/sec of SO_2 could cause in excess of 1 ppm throughout the valley. The only source which migh meet this criteria is the Union Carbide K-25 plant located 7-8 km northeast of the site. A

smaller source located closer to the monitoring site could cause greater than 1 ppm SO_2 levels, but one would expect to see a much more erratic trace.

Recommendations:

1) I would suggest you restrict the inlet line at site 7 for 24-48 hr and observe the resulting trace. This should be kept on file for future reference. I would also block the flush capillary (in another experiment) and observe the resulting trace. I would keep this record on file for future reference also.
2) I would find out if a portable calibrator had been left in the instrument building during the episode.
3) If the results of 1 and 2 are negative, then I would suspect that the measurements are of SO_2 in the outside air and not instrument malfunction anomalities.

Bob, I agree with the conclusions you reached in your report. I am generally impressed with the monitoring station setup, the maintenance and calibration procedures TVA uses, and the capabilities of the station operators. I have offered my recommendations only to assist your staff in an effort to uncover the cause of this peculiar and unusual event.

Sincerely yours,

ENVIRO-MEASURE, INC.

Terry L Miller

Terry L. Miller, Ph.D., P.E.
PRESIDENT

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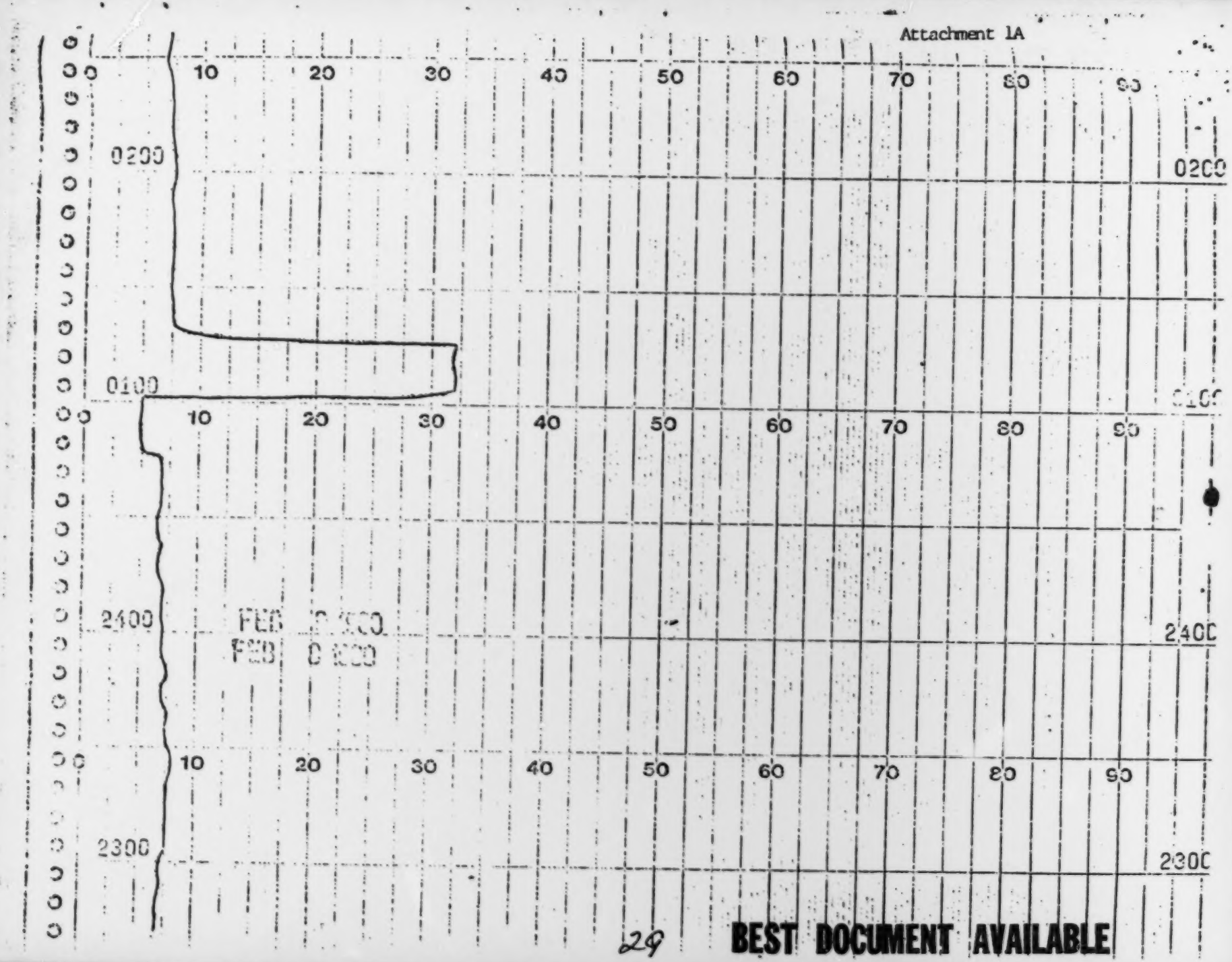
Attachment 1A



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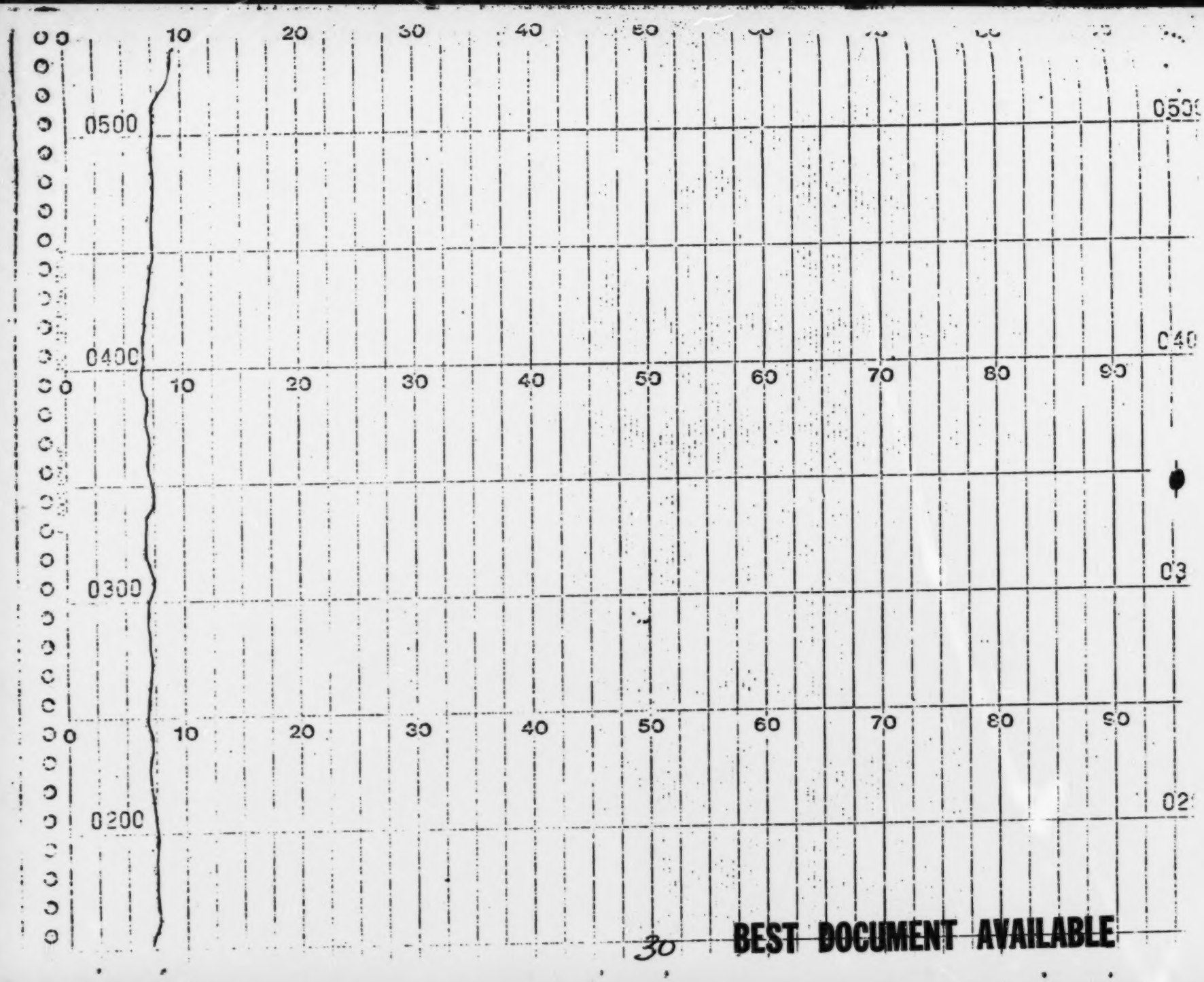

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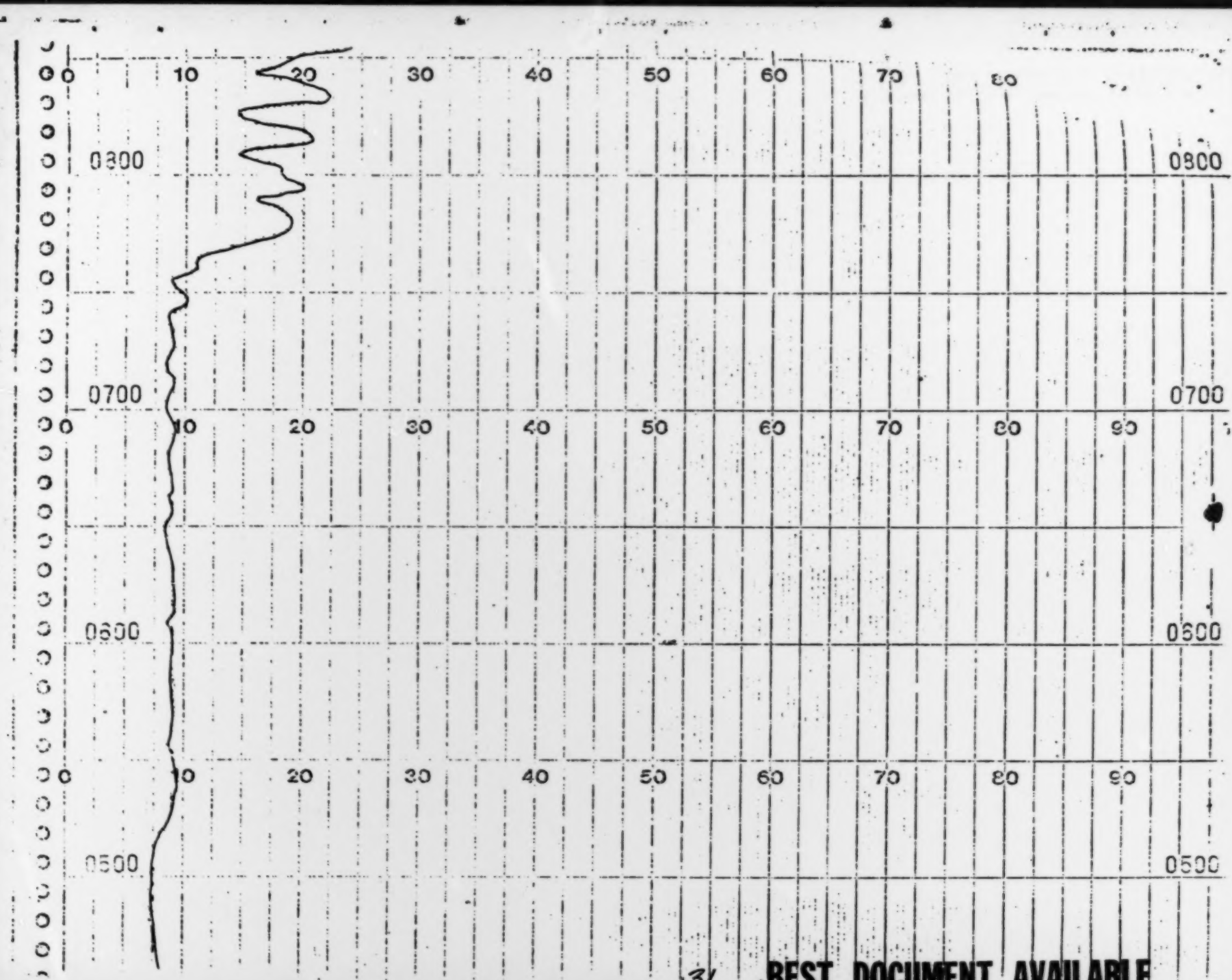

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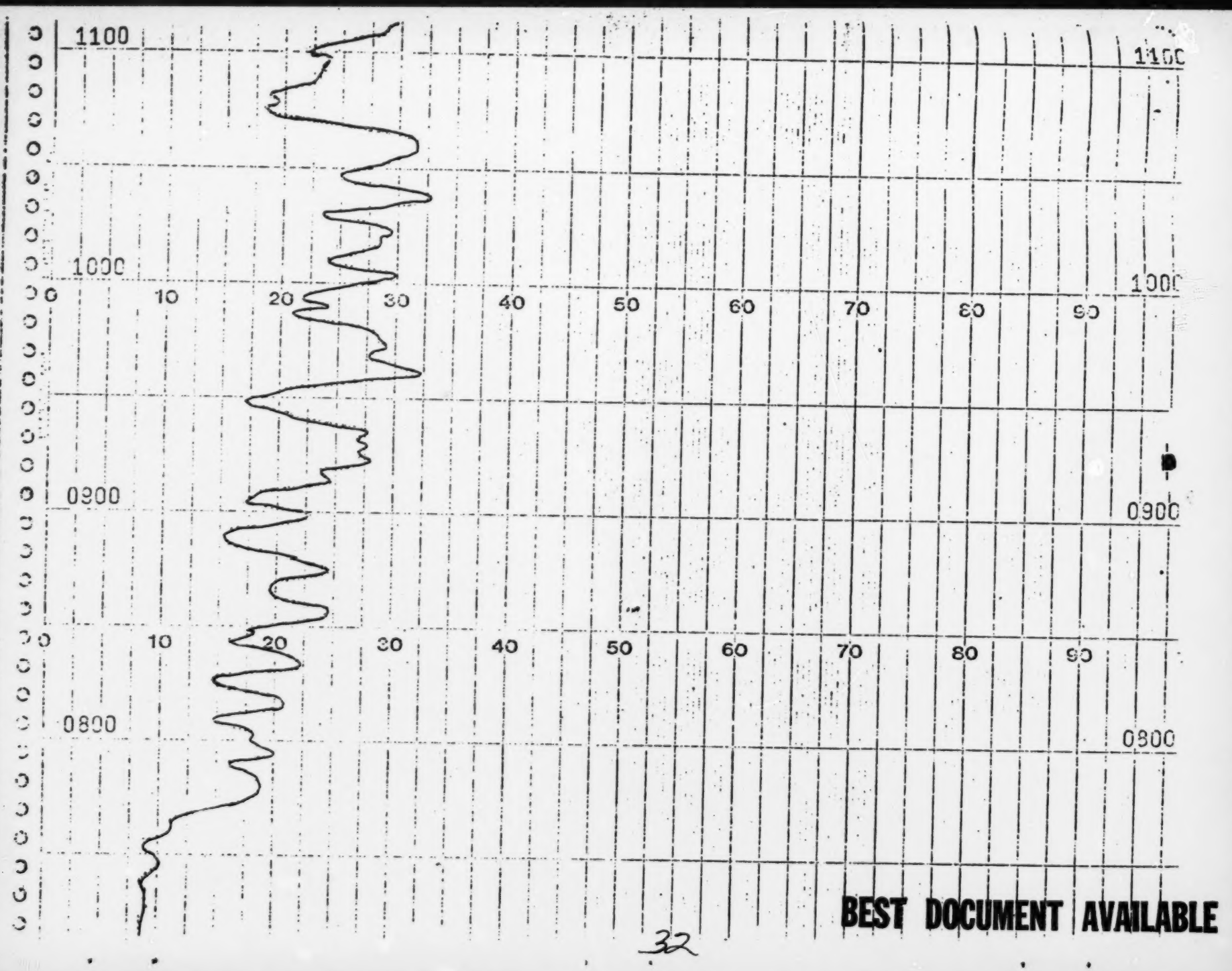

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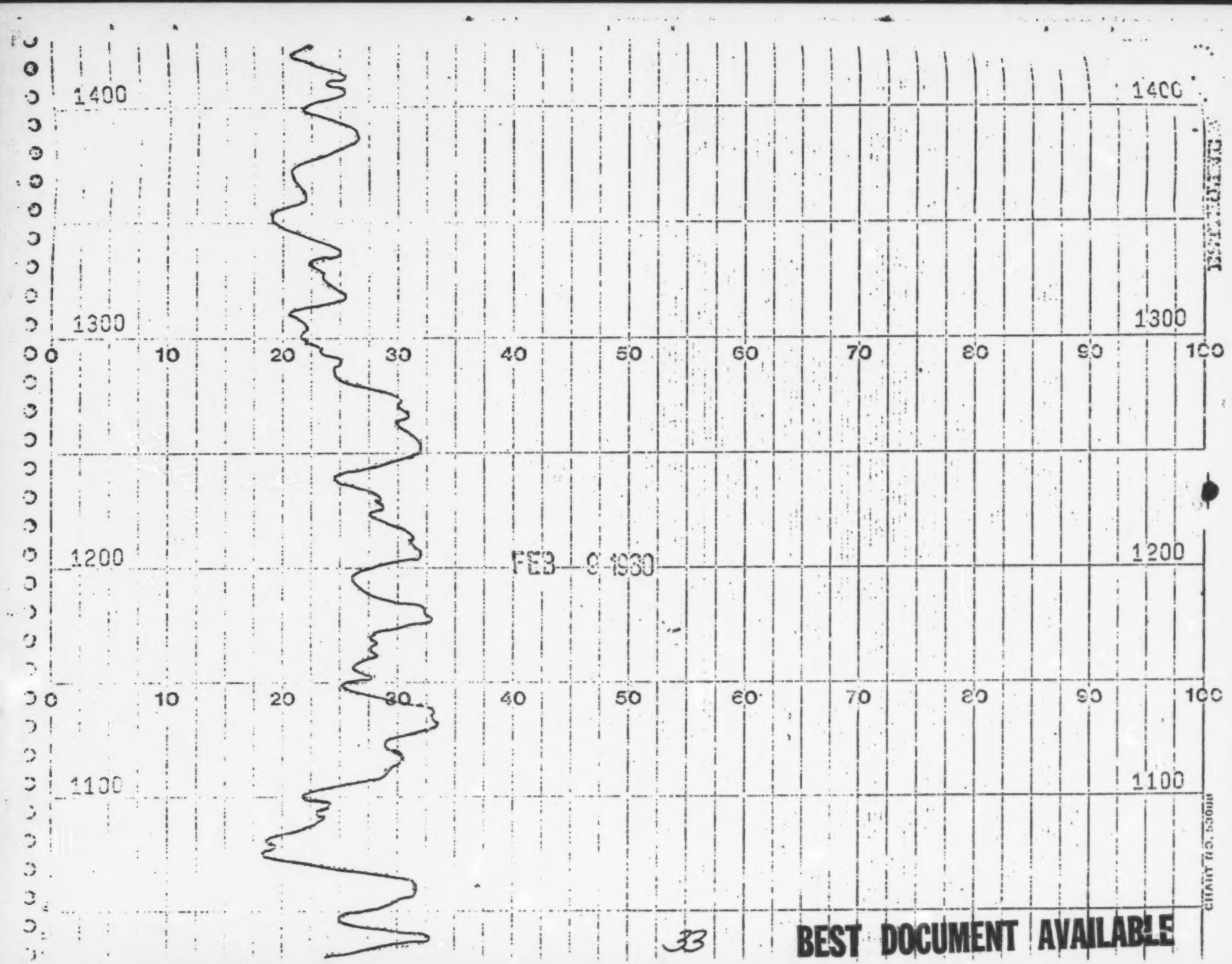
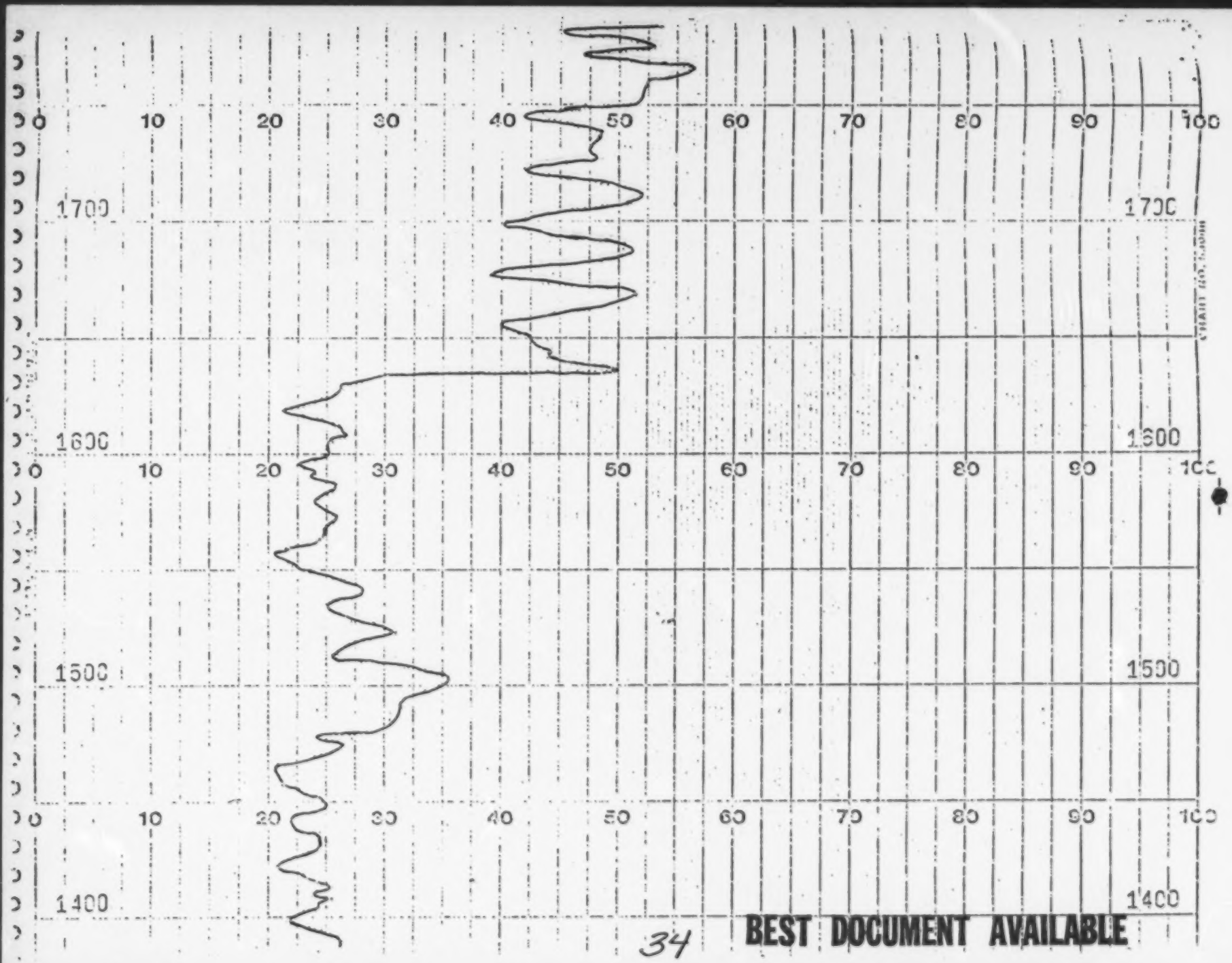


BEST DOCUMENT AVAILABLE



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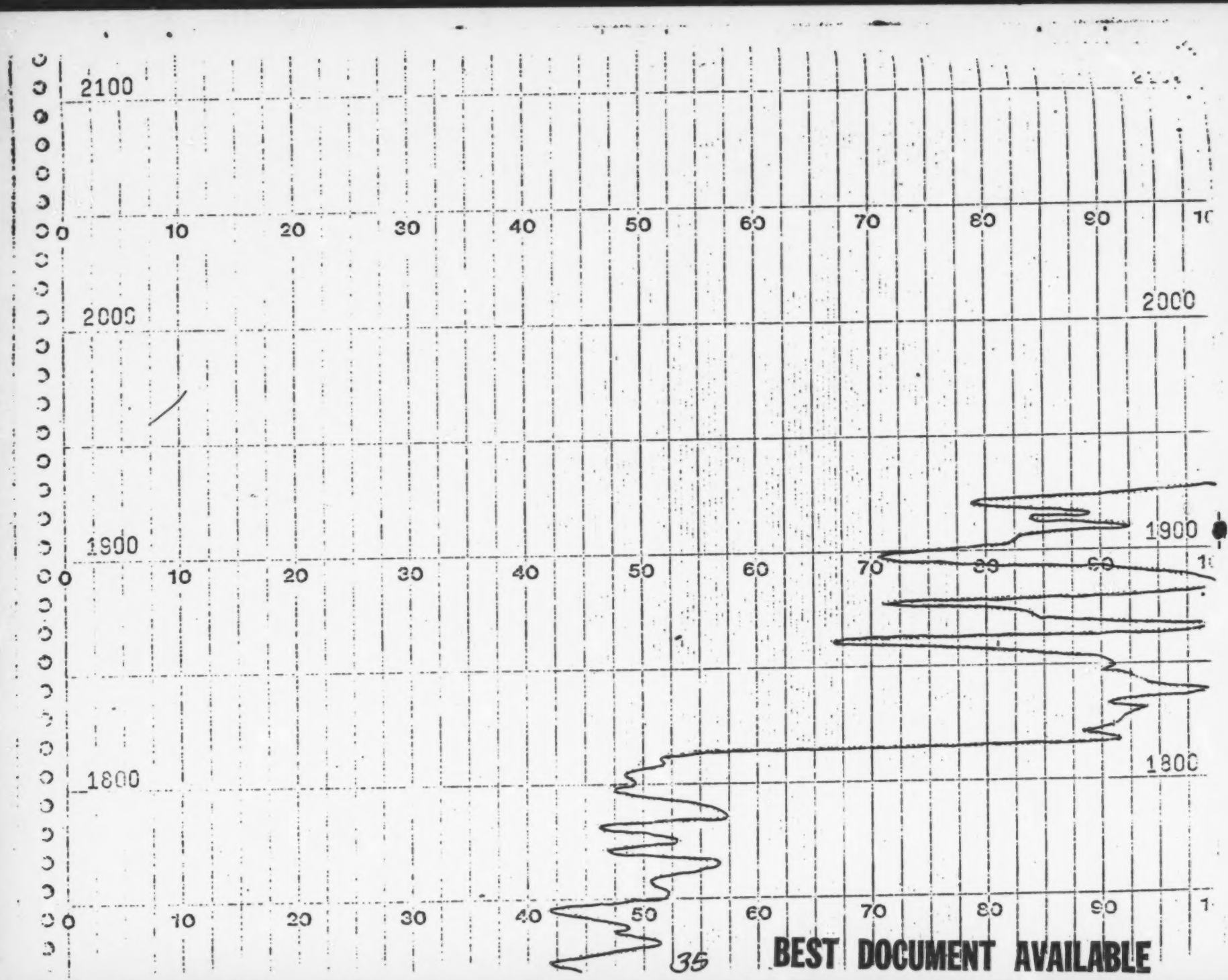

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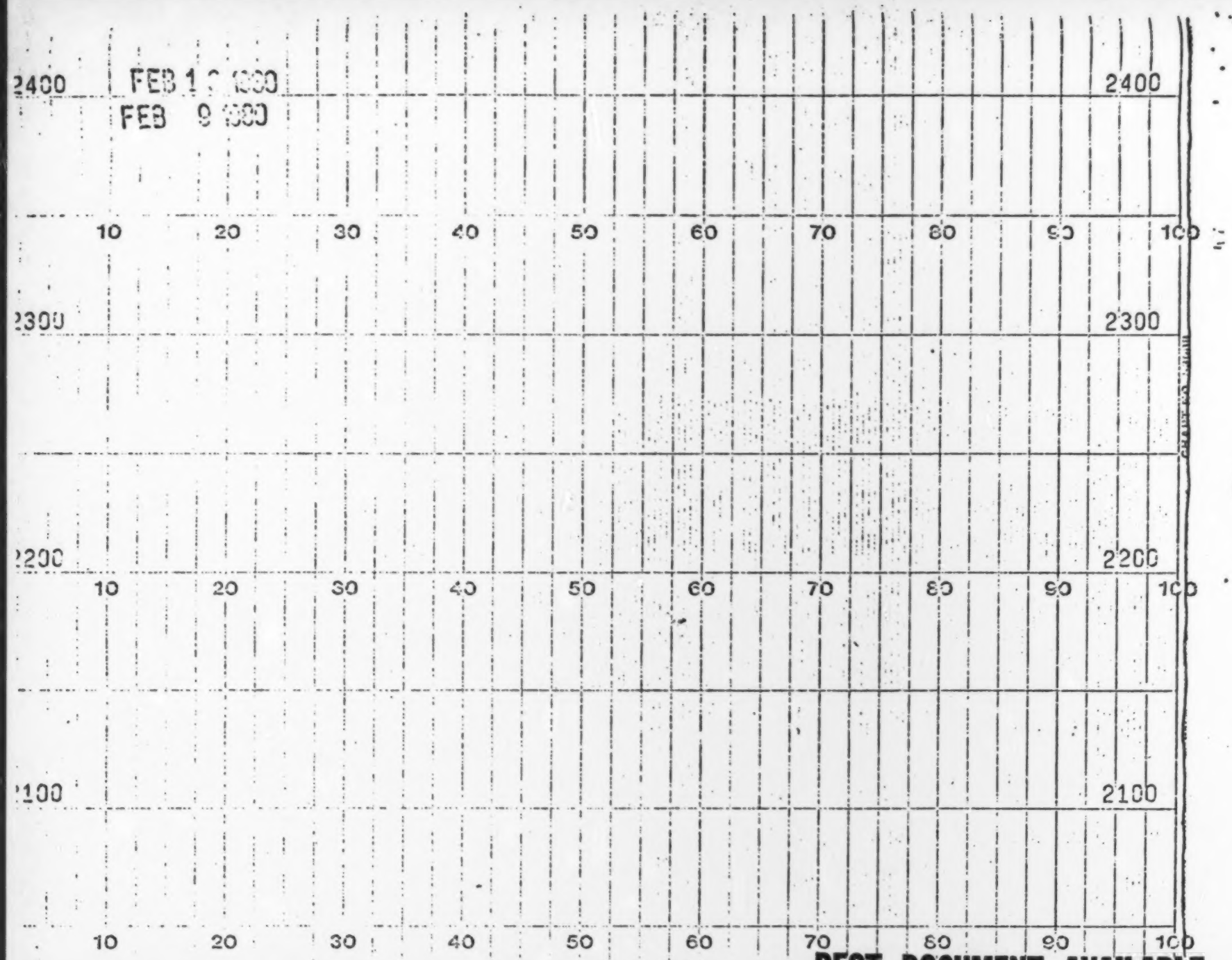

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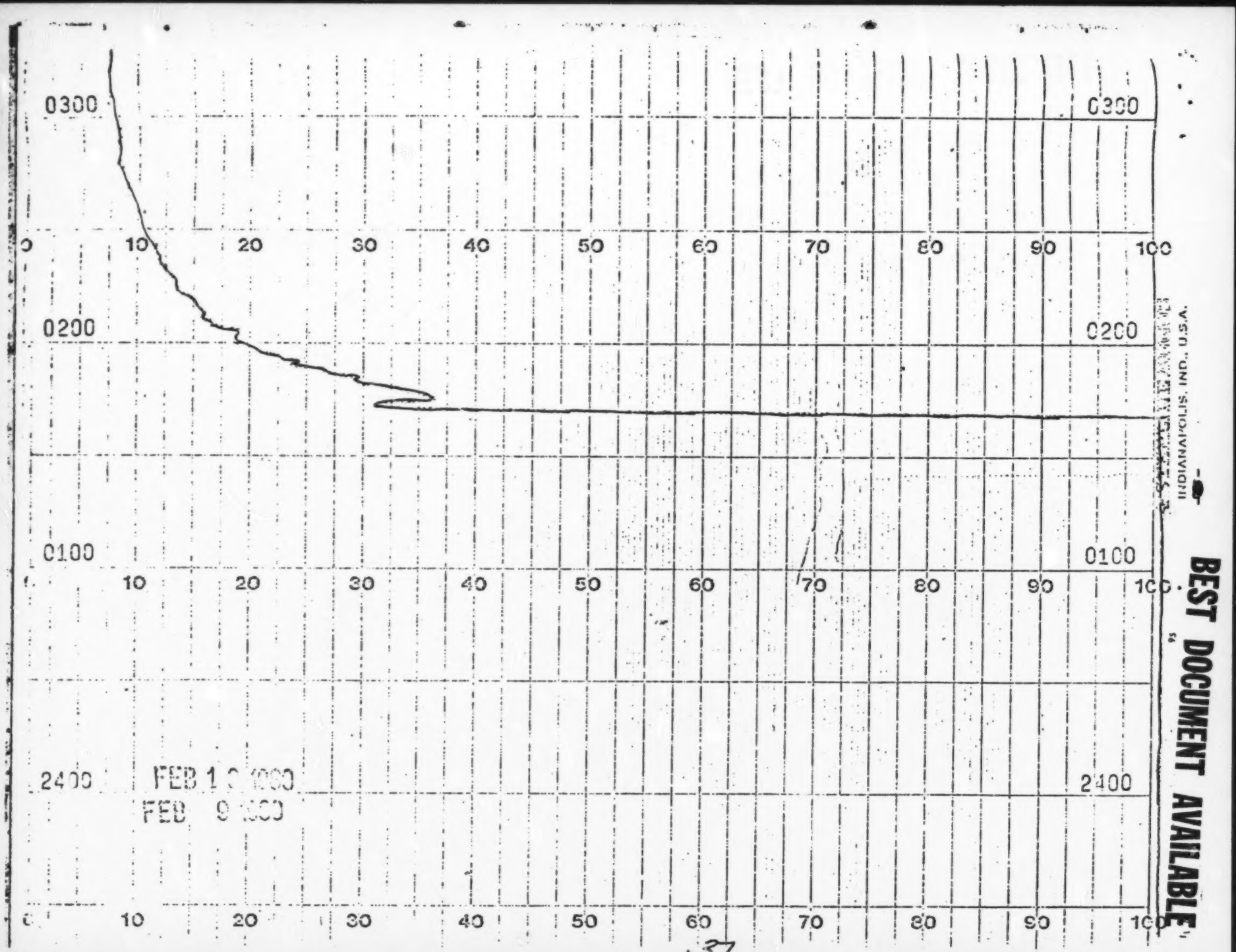

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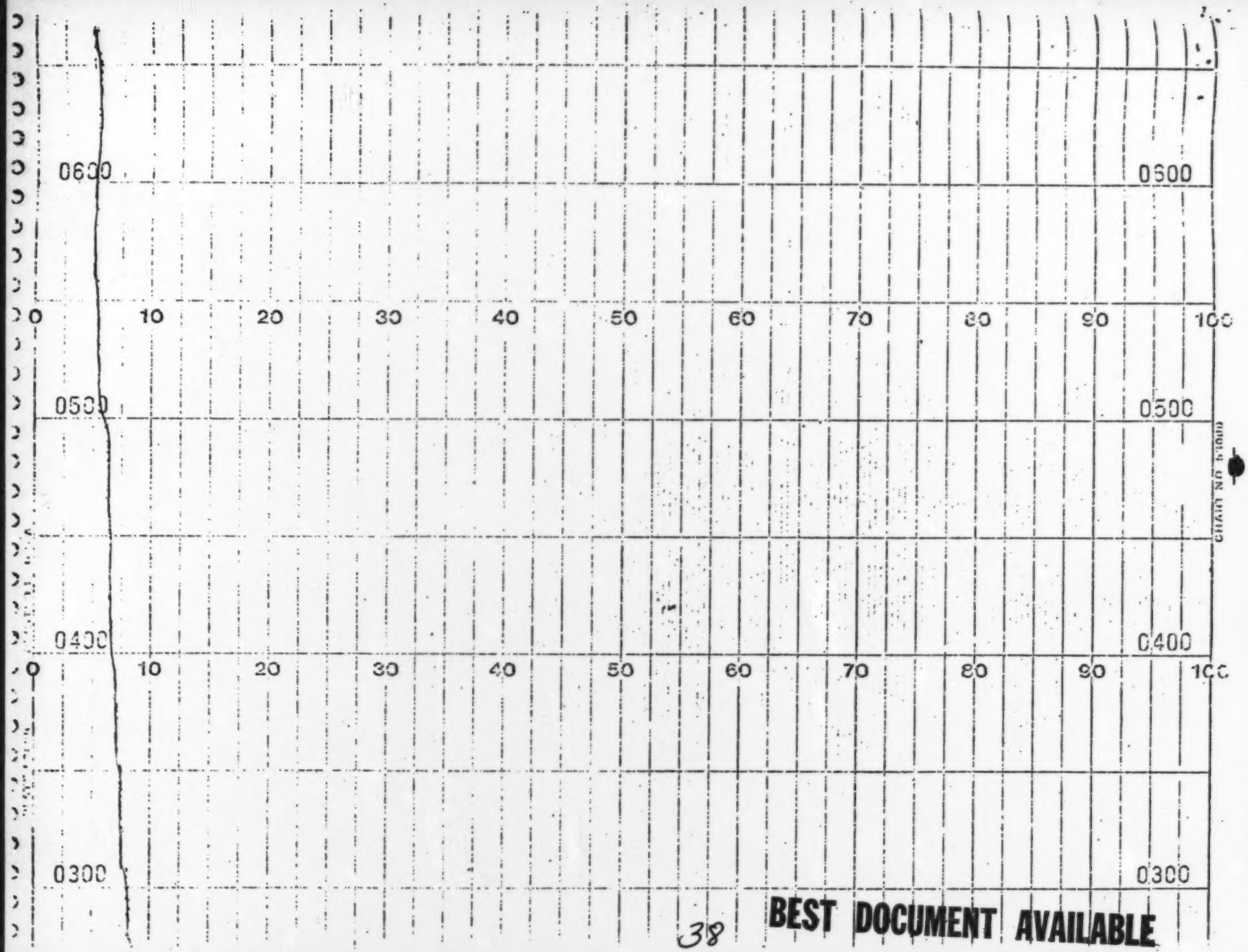

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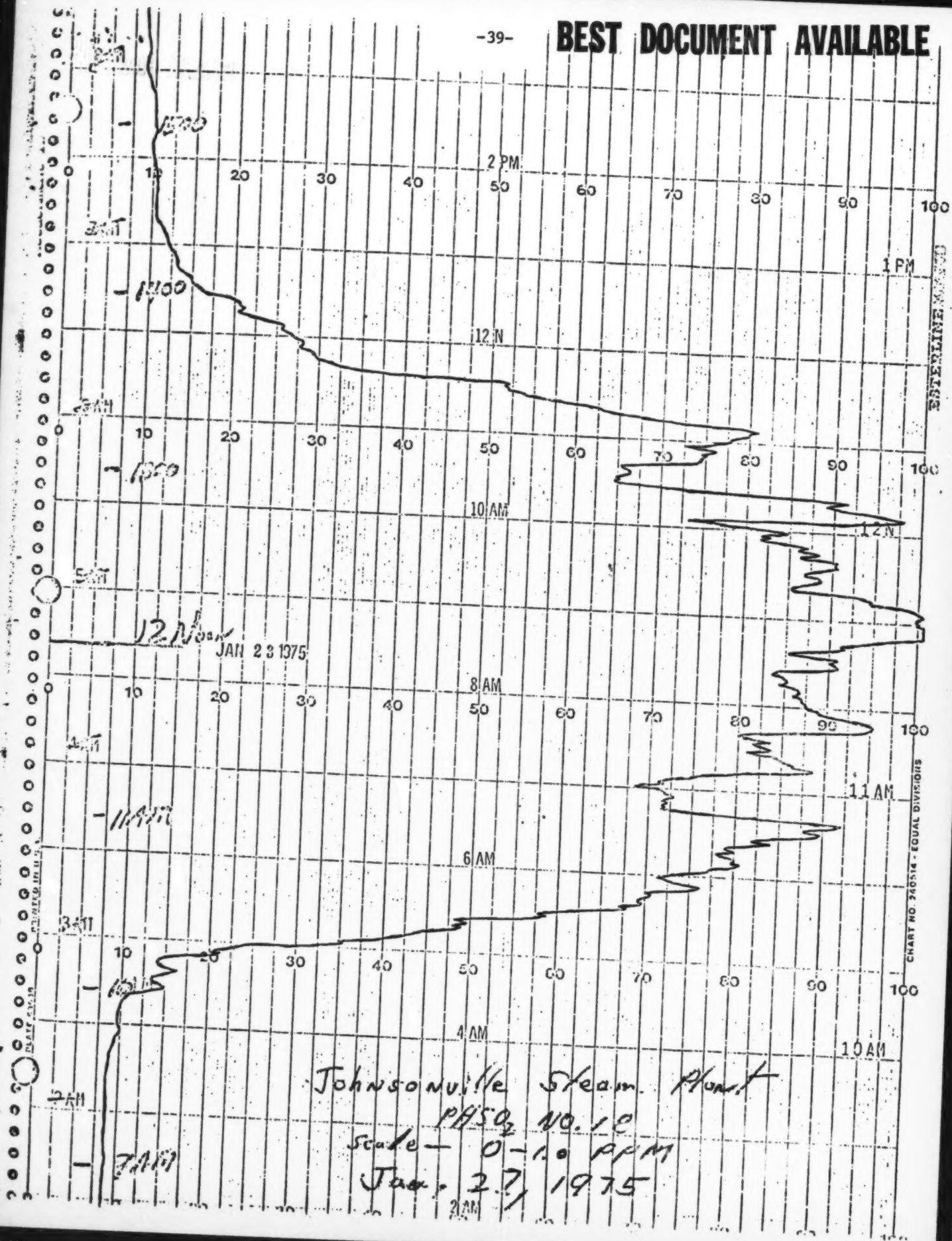

Johnsonville Steam Plant
PH_2SO_4 No. 1C
Scale — 0-10 ppm
Jan. 27, 1975

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Appendix B

SO_2 Concentration Data

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KINGSTON STEAM PLANT
STA 74 11
BC:055 02/24/80 (ACVA)

TENNESSEE VALLEY AUTHORITY
AMBIENT AIR CONCENTRATIONS (PPM)

PRINT-DATE 03/13/80
INITIALLY VALIDATED

PERIOD ENDG (CST)	PREV HO	WIND SPEED	SO2 PEAK STA 5 (049) AE	SO2 AVG STA 5 (229) BE	SO2 PEAK STA 7 (113) BG	SO2 AVG STA 7 (293) BG	SO2 PEAK STA 6 (143) AF	SO2 AVG STA 6 (323) BF	SO2 PEAK STA 9 (222) AI	SO2 AVG STA 9 (042) BI	PERIOD ENDG (CST)
0100	2	6.3		LR					.01	.01	0100
0200	351	12.3	.02	LR	.01	.01					0200
0300	351	12.3	.02	LR	.01	.01					0300
0400	354	11.6	.08	LR	.01	.01	.01		.01		0400
0500	1	12.3	.03	LR			.01		.01	.01	0500
0600	0	8.9	.08	LR					.01	.01	0600
0700	356	8.4		LR					.01	.01	0700
0800	342	10.9	.42	LR	.01		.01	.01	.01	.01	0800
0900	348	8.9	.01	LR	.02	.01	.01	.01	.01	.01	0900
1000	341	10.2	.01	LR	.09	.04	.05	.02	.01	.01	1000
1100	345	6.6	.01	LR	.15	.08	.17	.06	.01	.01	1100
1200	345	5.7	.01	LR	.31	.13	.15	.06	.01		1200
1300	49	4.2	.48	LR	.18	.11	.15	.07	.01	.01	1300
1400	30	4.2	.01	LR	.07	.03	.11	.01	.01		1400
1500	38	3.6	.04	LR	.04	.03	.02	.01			1500
1600	151	3.3	.02	LR	.05	.03	.05	.03			1600
1700	203	4.4	.01	LR	.03	.02	.02	.01			1700
1800	350	10.1	.01	LR	.03	.02	.01				1800
1900	347	22.7	.02	LR	.01	.01	.01	.01	.01		1900
2000	354	20.4	.59	LR	.01	.01	.01	.01			2000
2100	356	23.0	.05	LR	.01	.01	.01				2100
2200	1	21.1	.23	LR	.01	.01	.01	.01	.01		2200
2300	356	14.2	.06	LR	.01	.01	.01	.01	.01	.01	2300
2400	347	13.4	.01	LR	.01	.01	.01	.01			2400
AVRG	238	11.0		LR		.02		.01			AVRG

PERIOD ENDG (CST)	SO2 PEAK STA12 (242) AL	SO2 AVG STA12 (062) BL	SO2 PEAK STA10 (281) AJ	SO2 AVG STA10 (101) BJ	SO2 PEAK STA11 (326) AK	SO2 AVG STA11 (146) BK	SO2 PEAK STA 4 (328) AD	SO2 AVG STA 4 (148) BD	SO2 PEAK ST# 2 (347) AE	SO2 AVG STA 2 (167) BB	SO2 PEAK STA 8 (357) AH	SO2 AVG STA 8 (177) BH	PERIOD ENDG (CST)
0100	.01								.01				0100
0200									.01	.01	.01	.01	0200
0300			.01						.01		.01	.01	0300
0400	.01	.01	.01	.01	.01	.01			.01	.01	.01	.01	0400
0500	.01	.01	.01	.01	.02	.01			.01	.01	.02	.01	0500
0600	.01	.01	.01	.01	.02	.01	.01	.01	.01	.01	.02	.01	0600
0700	.01	.01	.02	.01	.02	.01	.01		.01	.01	.02	.01	0700
0800	.02	.01	.01	.01	.02	.01	.01		.02	.01	.01	.01	0800
0900	.02	.01	.02	.01	.02	.01	.01	.01	.02	.01	.01	.01	0900
1000	.02	.02	.01	.01	.02	.01	.01	.01	.02	.01	.01	.01	1000
1100	.02	.01	.01	.01	.02	.01			.01	.01	.01	.01	1100
1200	.01	.01	.01	.01	.01	.01			.01	.01	.01	.01	1200
1300	.01	.01			.01	.01			.01	.01	.01	.01	1300
1400	.01	.01	.01	.01	.05	.03	.01		.01	.01	.01	.01	1400
1500	.01	.01	.04	.02	.05	.03	.01	.01	.01	.01	.02	.01	1500
1600	.01	.01	.01		.08	.05	.04	.02	.01	.01	.03	.02	1600
1700	.01	.01			.04	.03	.03	.02	.01	.01	.03	.02	1700
1800	.01	.01							.01	.01	.01	.01	1800
1900	.01	.01	.01	.01	.01	.01			.01	.01	.01	.01	1900
2000	.01	.01	.01	.01	.01	.01			.01	.01	.01	.01	2000
2100	.01	.01	.01	.01	.01	.01			.01	.01	.01	.01	2100
2200	.02	.01	.02	.01	.01	.01	.01		.02	.01	.01	.01	2200
2300	.02	.01	.02	.01	.02	.01	.01		.02	.01	.01	.01	2300
2400	.01	.01	.01	.01	.01				.01	.01	.01	.01	2400
AVRG					.01							.01	AVRG

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2400			LR	.010	.010	.020	LR							
AVRG			.001		.006		LR		.002		.004		AVRG	

KINGSTON STEAM PLANT — TENNESSEE VALLEY AUTHORITY — PRINT-DATE 05/23/80
STA 74 11 — AMBIENT AIR CONCENTRATIONS (PPM) — VALIDATED
8w1121 04/30/80 (NOVA)

PERD ENDG (CDT)	PREV WD 110M C288	WIND SPEED 110M C2EB	SO2 PEAK STA 5 (049) AE	SO2 AVG STA 5 (229) BE	SO2 PEAK STA 7 (113) AG	SO2 AVG STA 7 (293) BG	SO2 PEAK STA 6 (143) AF	SO2 AVG STA 6 (323) BF	SO2 PEAK STA 9 (222) AI	SO2 AVG STA 9 (042) BI	PERD ENDG (CDT)
0100	307	3.4			.010	.010			.010	.010	0100
0200	320	2.6			.010		.010		.010	.010	0200
0300	347	4.5							.010	.010	0300
0400	337	7.6							.010		0400
0500	330	7.6							.010		0500
0600	352	10.3							.010		0600
0700	341	10.0							.010	.010	0700
0800	349	6.3	.010		.010	.010			.010	.010	0800
0900	319	7.3	.010	.010	.010	.010	.010		.010	.010	0900
1000	330	6.1	.010	.010	.020	.010	.070	.010	.010	.010	1000
1100	19	6.1	.010	.010	.010	.010	.050	.010	.010		1100
1200	18	3.5	.010	.010	.380	.080	.190	.070	.010	.010	1200
1300	153	5.4			.440	.230	.420	.180	.020	.010	1300
1400	200	5.4	.110	.030	.100	.040	.170	.040	.010	.010	1400
1500	222	6.6	.100	.050	.070	.040	.030	.010			1500
1600	246	8.3	.040	.010	IM	.020					1600
1700	273	6.4			.140	.040					1700
1800	354	6.7			.010	.010					1800
1900	351	9.9			.010	.010					1900
2000	343	10.9			.010	.010					2000
2100	340	13.5			.010	.010					2100
2200	338	15.6			.010	.010					2200
2300	343	13.8			.010	.010					2300
2400	346	11.0			.010	.010					2400
AVRG	286	7.8		.005		.023		.013		.004	AVRG

PERD ENDG (CDT)	SO2 PEAK STA12 (242) AL	SO2 AVG STA12 (062) BL	SO2 PEAK STA10 (281) AJ	SO2 AVG STA10 (101) BJ	SO2 PEAK STA11 (326) AK	SO2 AVG STA11 (146) BK	SO2 PEAK STA 4 (328) AD	SO2 AVG STA 4 (148) BD	SO2 PEAK STA 2 (347) AB	SO2 AVG STA 2 (167) BB	SO2 PEAK STA 8 (357) AH	SO2 AVG STA 8 (177) BH	PERD ENDG (CDT)
0100				LR	.010	.010	.020	LR			.010	.010	0100
0200			.010	.010	.010	.010		LR			.010	.010	0200
0300			.010		.010			LR					0300
0400			.010					LR					0400
0500								LR					0500
0600			.010	.010				LR					0600
0700			.010	.010	.010			LR					0700
0800	.010		.020	.010	.010	.010		LR			.010	.010	0800
0900	.010	.010	.020	.010	.010	.010		LR	.010	.010	.010	.010	0900
1000	.010	.010	.010	.010	.010	.010		LR	.010	.010	.010	.010	1000
1100	.010	.010	.020	.010	.010	.010		LR	.010	.010	.010	.010	1100
1200			.010	.010	.010	.010	.180	LR	.010	.010	.010	.010	1200
1300			.010	.010	.010	.010	IM	LR	.010		.010	.010	1300
1400			.010	.010	.060	.020	.060	LR			.100	.070	1400
1500	.010		.010	.010	.020	.010	.020	LR			.090	.030	1500
1600			.010	.010	.010	.010	.020	LR			.010	.010	1600
1700			.010	.010	.010	.010	.010	LR	.010		.010	.010	1700
1800			.010	.010	.010	.010	.020	LR	.010	.010	.010	.010	1800
1900			.010	.010	.010	.010	.010	LR	.010	.010	.010	.010	1900
2000			.010	.010	.010	.010	.010	LR	.010	.010	.010	.010	2000
2100			.010	.010	.010			LR	.010		.010	.010	2100
2200			.010	.010	.010			LR	.010		.010	.010	2200
2300			.010	.010	.010		.030	LR			.010	.010	2300
2400			.010	.010				LR					2400
AVRG					.004			LR		.002		.010	AVRG

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KINGSTON STEAM PLANT — TENNESSEE VALLEY AUTHORITY — PRINT-DATE 05/23/80
STA 74 11 — AMBIENT AIR CONCENTRATIONS (PPM) — VALIDATED
AC1116 04/25/80 (NOVA)

PERD ENDG (CST)	PREV HO 110M C2BB	WIND SPEED 110M C2EB	SO2 PEAK STA 5 (049) AE	SO2 AVG STA 5 (229) BE	SO2 PEAK STA 7 (113) AG	SO2 AVG STA 7 (293) BG	SO2 PEAK STA 6 (143) AF	SO2 AVG STA 6 (323) BF	SO2 PEAK STA 9 (222) AI	SO2 AVG STA 9 (042) BI	PERD ENDG (CST)
0100	322	9.5							.010		0100
0200	329	16.3			.010				.010	.010	0200
0300	326	16.3	.010		.010	.010			.010	.010	0300
0400	345	13.5	.010		.010	.010			.010	.010	0400
0500	328	9.2	.010		.010	.010			.010	.010	0500
0600	350	8.4	.010		.010	.010			.010	.010	0600
0700	332	7.4	.020	.010	.020	.010	.010		.010	.010	0700
0800	4	5.8	.020	.010	.010	.010	.010		.010	.010	0800
0900	23	4.4	.010	.010	.010	.010			.020	.020	0900
1000	142	3.2	.010	.010	.010	.010			.020	.010	1000
1100	359	2.4	.020	.010	.520	.070	.100	.050	.100	.040	1100
1200	29	2.1	.010	.010	.300	.140	.050	.030	.040	.040	1200
1300	58	4.6	.010	.010	.070	.040	.020	.010	.020	.010	1300
1400	69	2.7	.010	.010	.050	.040	.020	.010	.020	.010	1400
1500	347	14.1			IM	.010	IM	IM	.010		1500
1600	352	14.0									1600
1700	346	12.8									1700
1800	345	7.2									1800
1900	24	7.2	.020								1900
2000	65	11.3	.020		.010				.010		2000
2100	47	12.8			.010	.010					2100
2200	45	11.7			.010	.010					2200
2300	42	8.0									2300
2400	21	3.5									2400
AVRG	193	8.6		.003		.016		.004		.008	AVRG

PERD ENDG (CST)	SO2 PEAK STA12 (242) AL	SO2 AVG STA12 (062) BL	SO2 PEAK STA10 (281) AJ	SO2 AVG STA10 (101) BJ	SO2 PEAK STA11 (326) AK	SO2 AVG STA11 (146) BK	SO2 PEAK STA 4 (328) AD	SO2 AVG STA 4 (148) BD	SO2 PEAK STA 2 (347) AB	SO2 AVG STA 2 (167) BB	SO2 PEAK STA 8 (357) AH	SO2 AVG STA 8 (177) BH	PERD ENDG (CST)
0100			.010	.010	.010	.010	.020	LR			.010	.010	0100
0200			.010	.010	.040	.020	.050	LR	.010		.010		0200
0300			.010	.010	.030	.010	.100	LR	.010	.010	.010	.010	0300
0400	.010	.010	.010	.010	.050	.020	.170	LR	.010	.010	.010	.010	0400
0500	.010	.010	.010	.010	.020	.010	.030	LR	.010	.010	.010	.010	0500
0600	.010	.010	.010	.010	.020	.010	.080	LR	.010	.010	.010	.010	0600
0700	.010	.010	.010	.010	.020	.010	.170	LR	.020	.010	.010	.010	0700
0800	.010	.010	.010	.010	.130	.020	.080	LR	.020	.010	.010	.010	0800
0900	.010	.010	.010	.010	.080	.030	.110	LR	.010	.010	.010	.010	0900
1000	.010	.010	.010	.010	.050	.010	IM	LR	.010	.010	.010	.010	1000
1100	.010	.010	.010		.030	.020	.060	LR			.010	.010	1100
1200	.020	.010	.030	.010	.030	.020	IM	LR	.010		.010	.010	1200
1300	.020	.010	.020	.010	.040	.020	IM	LR	.010		.010	.010	1300
1400	.010	.010	.010	.010	.020	.010	NE	LR	.010		.010	.010	1400
1500	.010	.010	.020		.010	.010	.010	LR	.010		.010	.010	1500
1600					.010	.010	.290	LR			.010		1600
1700					.010		.010	LR					1700
1800					.010		.190	LR					1800
1900					.010			LR					190-
2000							.080	LR					2000
2100								LR					2100
2200					.010		IM	LR					220-
2300					.010	.010	.030	LR					2300
2400					.010		.020	LR					2400
AVRG		.003		.005		.010		LR		.003		.005	AVRG

BEST DOCUMENT AVAILABLE

KINGSTON STEAM PLANT — TENNESSEE VALLEY AUTHORITY — PRINT-DATE 07/31/80

STA 74 11 — AMBIENT AIR CONCENTRATIONS (PPM) — VALIDATED

80:143 05/22/80 (NOVA)

PERD ENDG (CDT)	PREV WD 110M 028B	WIND SPEED 110M 02EB	SO2 PEAK STA 5 (049) AE	SO2 AVG STA 5 (229) BE	SO2 PEAK STA 7 (113) AG	SO2 AVG STA 7 (293) BG	SO2 PEAK STA 6 (143) AF	SO2 AVG STA 6 (323) BF	SO2 PEAK STA 9 (222) AI	SO2 AVG STA 9 (042) BI	SO2 PEAK STA12 (242) AL	SO2 AVG STA12 (062) BL	PERD ENDG (CDT)
0100	64	8.1							.020	.010			0100
0200	63	8.6							.020	.010			0200
0300	64	9.9							.020	.010			0300
0400	81	8.0							.010	.010			0400
0500	60	10.4			IM	IM			.010				0500
0600	79	10.4			IM	IM			.020	.020			0600
0700	83	7.5			IM	IM			.010	.010			0700
0800	76	10.6			IM	IM			.010	.010	.010		0800
0900	76	9.6	.010		IM	IM	.020	.010	.020	.020	.010	.010	0900
1000	71	7.3	.030	.020	.020	.020	.030	.030	.050	.040	.040	.020	1000
1100	71	6.2	.030	.030	.020	.010	.030	.020	.050	.030	.050	.030	1100
1200	82	5.7	.040	.030	.480	.030	.020	.020	.030	.030	.020	.020	1200
1300	67	6.1	.040	.030	.020	.010	.020	.010	.040	.020	.030	.020	1300
1400	57	8.5	.030	.020	.020	.020	.020	.020	.030	.030	.030	.020	1400
1500	56	8.3	.010	.010	.010	.010	.010		.020	.010	.020	.010	1500
1600	88	7.8			IM	IM	.010		.010	.010			1600
1700	61	9.9			NE	NE							1700
1800	59	12.4			.010								1800
1900	64	13.4	.010		NE	NE							1900
2000	66	12.4			IM	IM							2000
2100	64	16.2			.010								2100
2200	69	19.8			NE	NE							2200
2300	71	16.5			NE	NE							2300
2400	211	8.7			IM	IM	.010		.010				2400
AVRG	75	10.0		.005		.008		.004		.011		.005	AVRG

PERD ENDG (CDT)	SO2 PEAK STA10 (281) AJ	SO2 AVG STA10 (101) BJ	SO2 PEAK STA11 (326) AK	SO2 AVG STA11 (146) BK	SO2PK TECO STA11 (326) AS	SO2AV TECO STA11 (146) BS	SO2 PEAK STA 4 (328) AD	SO2 AVG STA 4 (148) BD	SO2 PEAK STA 2 (347) AB	SO2 AVG STA 2 (167) BB	SO2 PEAK STA 8 (357) AH	SO2 AVG STA 8 (177) BH	PERD ENDG (CDT)
0100			.010		NF	NF	.010		.050	LR	.010	.010	0100
0200	.010		.010		NF	NF				LR			0200
0300			.010		NF	NF				LR			0300
0400			.010		NF	NF				LR	.010		0400
0500			.010		NF	NF				LR			0500
0600	.010		.010	.010	NF	NF				LR			0600
0700	.010		.220	.020	NF	NF				LR	.020	.010	0700
0800	.040	.010	.150	.060	NF	NF				LR	.010	.010	0800
0900	.050	.040	.010	.010	NF	NF			.940	LR	.010	.010	0900
1000	.030	.030	.020	.010	NF	NF			IM	LR	.020	.010	1000
1100	.030	.020	.020	.020	NF	NF			.050	LR	.030	.020	1100
1200	.030	.030	.020	.020	NF	NF			.010	LR	.020	.020	1200
1300	.040	.030	.030	.020	NF	NF				LR	.020	.010	1300
1400	.030	.020	.020	.020	NF	NF			.030	LR	.020	.020	1400
1500	.010	.010	.010	.010	NF	NF			.010	LR	.010	.010	1500
1600					NF	NF				LR			1600
1700					NF	NF			IM	LR			1700
1800					NF	NF				LR			1800
1900	.010		.010		NF	NF	.010			LR	.010		1900
2000					NF	NF				LR			2000
2100					NF	NF				LR			2100
2200					NF	NF				LR			2200
2300					NF	NF				LR			2300
2400					NF	NF				LR	.030		2400
AVRG		.007		.008		LR				LR		.005	AVRG

BEST DOCUMENT AVAILABLE

KINGSTON STEAM PLANT — TENNESSEE VALLEY AUTHORITY — PRINT-DATE 11/26/80
STA 74 11 — AMBIENT AIR CONCENTRATIONS (PPM) — VALIDATED
RC:221 10/07/80 (NOVA)

PERD ENDG (CDT)	PREV WD 11DM 0288	WIND SPEED 11DM 02E8	SO2 PEAK STA 5 (C49) AE	SO2 AVG STA 5 (229) BE	SO2 PEAK STA 7 (113) AG	SO2 AVG STA 7 (293) BG	SO2 PEAK STA 6 (143) AF	SO2 AVG STA 6 (323) BF	SO2 PEAK STA 9 (222) AI	SO2 AVG STA 9 (042) BI	SO2 PEAK STA12 (242) AL	SO2 AVG STA12 (062) BL	PERD ENDG (CDT)
0100	342	4.3	LR	LR					.010	.010			0100
0200	150	1.3	LR	LR					.010	.010			0200
0300	358	1.9	LR	LR					.010				0300
0400	346	5.1	LR	LR					.010				0400
0500	318	4.8	LR	LR					.010				0500
0600	0	5.1	LR	LR									0600
0700	45	2.7	LR	LR									0700
0800	105	2.1	LR	LR					IM	IM			0800
0900	11	2.6	LR	LR					IM	IM	.010		0900
1000	54	1.5	LR	LR					IM	IM	.010		1000
1100	105	2.8	LR	LR	.550	.120	.070	.030	NE	NE	.010	.010	1100
1200	209	5.6	LR	LR	.190	.040	.130	.060	.060	.020	.040	.030	1200
1300	229	5.1	LR	LR					.010		.020	.010	1300
1400	197	4.2	LR	LR							.010	.010	1400
1500	16	4.1	LR	LR							.010	.010	1500
1600	236	2.9	LR	LR	.010				.010	.010	.010	.010	1600
1700	166	5.8	LR	LR	.010				.010		.010		1700
1800	166	6.6	LR	LR					.010				1800
1900	172	7.8	LR	LR									1900
2000	198	6.0	LR	LR									2000
2100	206	4.3	LR	LR	.010				.010				2100
2200	208	2.7	LR	LR					.010				2200
2300	285	1.4	LR	LR	.010								2300
2400	84	1.8	LR	LR									2400
AVRG	177	3.8		LR		.006		.003		.002		.003	AVRG

PERD ENDG (CDT)	SC2 PEAK STA10 (281) AJ	SC2 AVG STA10 (101) BJ	SO2 PEAK STA11 (326) AK	SC2 AVG STA11 (146) BK	SC2PK TECO STA11 (326) A$	SC2AV TECO STA11 (146) B$	SO2 PEAK STA 4 (328) AD	SC2 AVG STA 4 (148) BD	SO2 PEAK STA 2 (347) AB	SO2 AVG STA 2 (167) B5	SO2 PEAK STA 8 (357) AH	SO2 AVG STA 8 (177) BH	PERD ENDG (CDT)
0100			.010		.010	.010							0100
0200	.010				.010								0200
0300	.010												0300
0400													0400
0500													0500
0600													0600
0700													0700
0800					.010								0800
0900					.010								0900
1000	.010						.010						1000
1100	.010	.010					.010		.010		.010		1100
1200	.020	.010	.020	.010	.010		.010		.010		.010	.010	1200
1300	.020	.010	.020	.020	.020	.010	.010		.010		.020	.020	1300
1400	.010	.010	.020	.010	.010	.010			.020	.010	.040	.030	1400
1500	.010		.010	.010	.010		.010		.020	.010	.020	.020	1500
1600	.010	.010	.010	.010	.010	.010	.010		.020	.010	.030	.020	1600
1700			.010	.010	.010		.010	.010	.010	.010	.020	.010	1700
1800	.010	.010	.010				.010		.010	.010	.010		1800
1900	.010	.010					.020	.010	.010				1900
2000	.010	.010	.010				.010	.010					2000
2100	.010	.010	.070	.040							.010		2100
2200	.010		.060	.050			.010		.010		.010		2200
2300	.010		.030	.020			.010						2300
2400	.010												2400
AVRG		.003		.007		.001		.001		.002		.004	AVRG

BEST DOCUMENT AVAILABLE

Ambient SO_2 Monitoring Data
Union Carbide Y-12 Plant

Date	Hour Ending (CST)	3-Hour Running Averages Concentration Station A* $\mu g/m^3$	Station A* ppm	Station B* $\mu g/m^3$	Station B* ppm
February 8, 1980	0100	13	0.005	136	0.052
	0200	13	.005	142	.055
	0300	13	.005	148	.057
	0400	13	.005	137	.053
	0500	13	.005	141	.054
	0600	13	.005	154	.059
	0700	13	.005	160	.062
	0800	13	.005	201	.077
	0900	13	.005	180	.069
	1000	13	.005	200	.077
	1100	13	.005	185	.071
	1200	13	.005	211	.081
	1300	13	.005	189	.073
	1400	13	.005	154	.059
	1500	13	.005	140	.054
	1600	13	.005	134	.052
	1700	13	.005	122	.047
	1800	13	.005	107	.041
	1900	13	.005	97	.037
	2000	13	.005	104	.040
	2100	13	.005	100	.038
	2200	13	.005	79	.030
	2300	13	.005	56	.022
	2400	13	.005	20	.008
February 9, 1981	0100	13	.005	13	.005
	0200	13	.005	13	.005
	0300	13	.005	13	.005
	0400	13	.005	13	.005
	0500	13	.005	13	.005
	0600	13	.005	13	.005
	0700	13	.005	13	.005
	0800	13	.005	13	.005
	0900	13	.005	13	.005
	1000	13	.005	13	.005
	1100	13	.005	19	.007
	1200	13	.005	19	.007
	1300	13	.005	19	.007
	1400	13	.005	13	.005
	1500	13	.005	13	.005
	1600	13	.005	13	.005
	1700	13	.005	13	.005
	1800	13	.005	13	.005

BEST DOCUMENT AVAILABLE

Ambient SO_2 Monitoring Data
Union Carbide Y-12 Plant
(Continued)

Date	Hour Ending (CST)	3-Hour Running Averages Concentration Station A* µg/m³	Station A* ppm	Station B* µg/m³	Station B* ppm
	1900	13	.005	13	.005
	2000	13	.005	13	.005
	2100	13	.005	13	.005
	2200	13	.005	13	.005
	2300	13	.005	13	.005
	2400	13	.005	20	.008
February 10, 1981	0100	13	.005	34	.013
	0200	13	.005	40	.015
	0300	13	.005	53	.020
	0400	13	.005	62	.024
	0500	13	.005	66	.025
	0600	13	.005	67	.026
	0700	13	.005	68	.026
	0800	13	.005	67	.026
	0900	13	.005	61	.023
	1000	13	.005	54	.021
	1100	13	.005	56	.022
	1200	13	.005	87	.033
	1300	13	.005	134	.052
	1400	13	.005	166	.064
	1500	13	.005	155	.060
	1600	13	.005	115	.044
	1700	13	.005	72	.028
	1800	13	.005	39	.015
	1900	13	.005	20	.008
	2000	13	.005	13	.005
	2100	13	.005	13	.005
	2200	13	.005	13	.005
	2300	13	.005	13	.005
	2400	13	.005	13	.005

Note: 13 µg/m³ (0.005 ppm) is the minimum detectable limit of the monitoring instrument.

*Station A is 21.6 km east-northeast (64°) from Kingston station 7; station B is 20.6 km northeast (54°) from Kingston station 7.

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Appendix C

Meteorological Data

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KINGSTON STEAM PLANT
METEORLOGICAL TOWER DATA VALLEY
FEBRUARY 24, 1980

HOUR ENDING (CDT)	110-METER WINDS WIND SPEED (M/S)	110-METER WINDS WIND DIRECTION (DEG)	110-METER WINDS PERSISTANCE (%)	10-METER WINDS WIND SPEED (M/S)	10-METER WINDS WIND DIRECTION (DEG)	10-METER WINDS PERSISTANCE (%)	TEMP 110-METER (DEG C)	TEMP 10-METER (DEG C)	TEMP 1-METER (DEG C)	SOLAR RADIATION (LY/MIN)
100	2.8	2	48	1.0	6	15	*****	*****	*****	0.0
200	5.5	353	68	1.9	351	29	*****	*****	*****	0.0
300	5.5	351	75	1.7	354	36	*****	*****	*****	0.0
400	5.3	354	67	1.8	346	39	*****	*****	*****	0.0
500	5.5	1	75	1.7	356	27	*****	*****	*****	0.0
600	4.0	6	93	0.9	83	31	*****	*****	*****	0.0
700	3.8	359	70	0.9	19	38	*****	*****	*****	0.03
800	4.9	342	71	2.0	344	41	*****	*****	*****	0.23
900	3.8	348	62	2.3	343	38	*****	*****	*****	0.54
1000	4.5	341	59	3.0	339	36	*****	*****	*****	0.78
1100	3.0	345	43	2.1	333	25	*****	*****	*****	0.98
1200	2.5	345	38	1.9	2	28	*****	*****	*****	1.08
1300	1.9	49	20	1.7	121	17	*****	*****	*****	1.06
1400	1.9	36	38	1.5	21	29	*****	*****	*****	0.94
1500	1.6	38	33	1.3	19	16	*****	*****	*****	0.73
1600	1.5	151	34	1.0	149	17	*****	*****	*****	0.46
1700	1.0	203	47	0.6	265	22	*****	*****	*****	0.18
1800	8.1	350	83	4.4	351	51	*****	*****	*****	0.01
1900	10.1	347	83	5.4	345	48	*****	*****	*****	0.0
2000	9.1	354	65	4.3	357	39	*****	*****	*****	0.0
2100	10.3	356	67	5.2	349	40	*****	*****	*****	0.0
2200	9.4	1	69	5.2	354	42	*****	*****	*****	0.0
2300	6.3	356	81	3.0	348	46	*****	*****	*****	0.0
2400	6.0	347	74	2.4	345	36	*****	*****	*****	0.0

* INDICATES LOST RECORDS

BEST DOCUMENT AVAILABLE

KINGSTON STEAM PLANT

METEORLOGICAL TOWER DATA VALLEY

APRIL 25, 1980

HOUR ENDING (CDT)	110-METER WINDS WIND SPEED (M/S)	110-METER WINDS WIND DIRECTION (DEG)	110-METER WINDS PERSISTANCE (%)	10-METER WINDS WIND SPEED (M/S)	10-METER WINDS WIND DIRECTION (DEG)	10-METER WINDS PERSISTANCE (%)	TEMP 110-METER (DEG C)	TEMP 10-METER (DEG C)	TEMP 1-METER (DEG C)	SOLAR RADIATION (LY/MIN)
100	4.2	322	59	1.8	317	31	16.2	15.8	15.3	0.0
200	7.3	329	90	2.9	330	44	14.1	14.6	14.3	0.0
300	7.3	326	47	3.1	329	27	12.4	13.0	12.7	0.0
400	6.0	345	68	2.3	347	35	11.5	12.0	11.8	0.0
500	4.1	328	48	1.7	322	23	10.8	11.5	11.1	0.0
600	3.8	350	55	1.8	326	29	10.4	11.2	11.1	0.04
700	3.3	332	43	1.9	330	30	10.1	11.0	11.2	0.19
800	2.6	4	61	1.5	356	31	10.8	12.1	12.7	0.61
900	2.0	23	42	1.4	20	23	12.5	14.0	14.7	0.93
1000	1.4	142	15	1.3	17	11	15.2	16.5	17.4	1.13
1100	1.1	359	24	1.1	38	20	16.6	17.8	18.6	0.85
1200	0.9	29	34	0.9	9	22	17.6	18.7	19.2	0.54
1300	2.1	58	28	1.5	70	22	18.9	20.2	20.8	0.94
1400	1.2	69	17	1.3	59	19	19.2	20.2	20.5	0.49
1500	6.3	347	61	3.5	339	40	18.5	19.9	20.4	0.66
1600	6.3	352	71	3.4	339	41	17.3	18.6	19.0	0.48
1700	5.7	346	80	3.1	344	45	16.6	17.8	18.1	0.35
1800	3.2	345	69	1.7	343	43	16.4	17.2	17.1	0.10
1900	3.2	24	58	1.0	64	26	15.8	16.0	15.5	0.01
2000	5.1	65	74	1.9	70	49	14.9	15.3	15.0	0.0
2100	5.7	47	91	1.9	66	41	14.4	14.7	14.5	0.0
2200	5.2	45	96	1.6	66	34	14.1	14.5	14.3	0.0
2300	3.6	42	80	0.8	43	23	13.6	13.9	13.6	0.0
2400	1.6	21	43	0.8	268	21	12.2	12.2	11.9	0.0

* INDICATES LOST RECORDS

BEST DOCUMENT AVAILABLE

KINGSTON STEAM PLANT
METEORLOGICAL TOWER DATA VALLEY
APRIL 30, 1980

HOUR ENDING (CDT)	110-METER WINDS WIND SPEED (M/S)	110-METER WINDS WIND DIRECTION (DEG)	110-METER WINDS PERSISTANCE (%)	10-METER WINDS WIND SPEED (M/S)	10-METER WINDS WIND DIRECTION (DEG)	10-METER WINDS PERSISTANCE (%)	TEMP 110-METER (DEG C)	TEMP 10-METER (DEG C)	TEMP 1-METER (DEG C)	SOLAR RADIATION (LY/MIN)
100	1.5	307	30	0.8	147	33	7.5	7.5	5.8	0.0
200	1.2	320	24	0.5	2	16	7.4	6.7	5.1	0.0
300	2.0	347	62	0.9	40	29	6.9	6.2	4.7	0.0
400	3.4	337	89	0.7	345	19	6.7	6.2	4.7	0.0
500	3.4	330	84	1.1	327	39	6.8	6.0	4.7	0.0
600	4.6	352	99	0.9	33	37	6.6	5.0	4.3	0.0
700	4.5	341	91	1.2	320	23	6.5	5.4	4.9	0.11
800	2.8	349	40	1.3	309	29	6.0	7.0	7.2	0.36
900	3.3	319	55	2.4	318	42	7.	8.3	9.0	0.64
1000	2.7	330	41	1.9	326	38	8.9	10.4	11.2	0.92
1100	2.7	19	52	1.9	13	23	10.7	12.4	13.3	1.18
1200	1.6	18	26	1.5	16	17	12.6	14.0	14.8	1.29
1300	2.4	153	45	2.0	148	32	13.6	14.9	15.5	0.79
1400	2.4	200	35	1.9	151	22	14.2	15.4	15.8	0.49
1500	3.0	222	53	2.0	237	34	14.8	16.4	17.1	0.86
1600	3.7	246	54	2.2	247	38	14.9	16.0	16.3	0.33
1700	2.9	273	41	1.7	257	32	14.9	15.8	15.8	0.18
1800	3.0	354	61	1.3	334	50	14.8	15.6	15.5	0.15
1900	4.4	351	91	2.2	337	54	14.8	15.5	15.2	0.04
2000	4.9	343	95	2.1	332	60	14.4	14.9	14.3	0.01
2100	6.0	340	97	2.5	333	56	13.8	13.7	12.8	0.0
2200	7.0	338	98	2.5	336	54	13.3	13.1	12.5	0.0
2300	6.2	343	97	2.1	342	41	12.9	12.9	12.4	0.0
2400	4.9	346	82	1.6	335	42	12.1	12.4	11.9	0.0

• INDICATES LOST RECORDS

BEST DOCUMENT AVAILABLE

KINGSTON STEAM PLANT

METEORLOGICAL TOWER DATA VALLEY

MAY 22, 1980

HOUR ENDING (CDT)	110-METER WINDS WIND SPEED (M/S)	110-METER WINDS WIND DIRECTION (DEG)	110-METER WINDS PERSISTANCE (%)	10-METER WINDS WIND SPEED (M/S)	10-METER WINDS WIND DIRECTION (DEG)	10-METER WINDS PERSISTANCE (%)	TEMP 110-METER (DEG C)	TEMP 10-METER (DEG C)	TEMP 1-METER (DEG C)	SOLAR RADIATION (LY/MIN)
100	3.6	64	100	0.6	15	29	17.9	15.8	15.6	0.0
200	3.8	63	99	0.8	46	39	17.2	15.4	15.2	0.0
300	4.4	64	98	0.8	46	28	16.6	15.0	14.8	0.0
400	3.6	81	99	0.6	30	37	15.9	14.7	14.3	0.0
500	4.6	60	95	1.0	49	35	15.8	14.2	14.1	0.0
600	4.6	79	95	0.6	33	54	15.6	14.1	14.0	0.0
700	3.4	83	80	0.4	38	40	14.9	14.4	14.4	0.05
800	4.7	76	98	0.8	48	36	15.6	14.9	15.0	0.13
900	4.3	76	82	0.6	353	37	16.3	16.3	16.5	0.26
1000	3.3	71	56	1.4	62	25	17.9	19.0	19.5	0.58
1100	2.8	71	53	1.6	58	25	19.1	20.4	20.8	0.51
1200	2.5	82	79	1.4	108	32	19.5	20.6	20.8	0.35
1300	2.7	67	54	1.4	65	31	19.8	20.8	21.1	0.36
1400	3.8	57	91	1.7	58	44	19.9	20.8	21.0	0.23
1500	3.7	56	77	1.1	51	36	19.4	19.9	20.0	0.15
1600	3.5	88	60	1.0	67	36	18.8	19.4	19.4	0.10
1700	4.4	61	76	1.4	52	49	18.4	18.9	19.0	0.09
1800	5.5	59	96	1.8	60	52	17.9	18.4	18.4	0.10
1900	6.0	64	98	1.8	62	54	18.0	18.3	18.3	0.06
2000	5.5	66	83	1.5	70	46	18.1	18.4	18.3	0.01
2100	7.2	64	92	2.3	67	51	17.6	18.0	17.9	0.0
2200	8.9	59	93	2.5	83	44	17.5	17.6	17.6	0.0
2300	7.4	71	73	2.1	79	43	17.5	17.7	17.7	0.0
2400	3.9	211	32	1.5	220	28	17.2	17.7	17.6	0.0

* INDICATES LOST RECORDS

BEST DOCUMENT AVAILABLE

KINGSTON STEAM PLANT
METEORLOGICAL TOWER DATA VALLEY
OCTOBER 7, 1980

HOUR ENDING (CDT)	110-METER WINDS WIND SPEED (M/S)	110-METER WINDS WIND DIRECTION (DEG)	110-METER WINDS PERSISTANCE (%)	10-METER WINDS WIND SPEED (M/S)	10-METER WINDS WIND DIRECTION (DEG)	10-METER WINDS PERSISTANCE (%)	TEMP 110-METER (DEG C)	TEMP 10-METER (DEG C)	TEMP 1-METER (DEG C)	SOLAR RADIATION (LY/MIN)
100	1.9	342	51	0.9	33	39	*****	6.6	6.2	0.0
200	0.6	150	59	1.0	25	39	*****	6.0	5.7	0.0
300	0.8	358	40	1.0	30	36	*****	5.4	5.2	0.0
400	2.3	346	97	1.1	31	[illegible]	*****	5.0	4.8	0.0
500	2.1	338	69	0.7	50	42	*****	4.6	4.4	0.0
600	2.3	0	71	0.7	68	21	*****	4.3	4.3	0.0
700	1.2	94	66	0.5	338	24	*****	4.4	4.5	0.01
800	0.9	105	43	0.7	3	28	*****	4.4	4.6	0.07
900	1.2	11	62	0.6	85	19	*****	5.5	5.8	0.30
1000	0.7	54	23	0.7	345	13	*****	8.4	9.0	0.71
1100	1.3	105	17	1.1	109	13	*****	12.1	12.7	0.91
1200	2.5	209	57	1.8	208	27	*****	15.1	15.9	1.05
1300	2.3	209	43	1.8	240	33	*****	17.6	18.2	1.09
1400	1.9	197	27	1.3	156	13	*****	19.2	19.7	1.03
1500	1.8	16	12	1.3	322	16	*****	20.5	21.0	0.89
1600	1.3	236	18	1.1	247	11	*****	21.5	21.7	0.67
1700	2.6	166	70	1.6	162	49	*****	21.8	21.9	0.39
1800	3.0	166	85	0.9	156	67	*****	20.6	18.9	0.08
1900	3.5	172	56	0.8	121	42	*****	18.6	15.6	0.0
2000	2.7	198	100	0.7	153	43	*****	15.9	13.8	0.0
2100	1.9	206	89	0.6	90	35	*****	14.2	12.1	0.0
2200	1.2	208	58	0.7	51	37	*****	12.5	11.1	0.0
2300	0.6	285	36	0.4	71	43	*****	11.8	10.4	0.0
2400	0.8	84	35	0.8	40	45	*****	11.4	10.4	0.0

* INDICATES LOST RECORDS

BEST DOCUMENT AVAILABLE